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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 33

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# USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

## ELECTRONICS AND ELECTRICAL ENGINEERING

### No. 33

This serial publication contains abstracts of articles and news items from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

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ELECTRICAL ENGINEERING

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ELECTRONICS
Amplifiers

AMPLIFIER BASED ON EQUIVALENT OF A P-N-P-N STRUCTURE WITH CONTROLLED
CURRENT-VOLTAGES OF S-TYPE

AREF'YEV, A. A. and STEPANOVA, L. N.

/Abstract/ Measuring voltage amplifiers must satisfy increased require-
ments on the stability of the amplification factor in a prescribed range
of performance of destabilizing factors. As shown in the literature,
known methods of stabilization amount primarily to the use of negative or
combined local or overall feedback. New elements are also used which make
it possible in specific cases to simplify the construction of measuring
amplifiers. From this point of view, the prospect is presented of the use
of the transistor equivalents of a p-n-p-n structure with controlled cur-
rent S-type current-voltage characteristic (CVC). The presence of internal
positive and negative feedback makes it possible to stabilize the amplifi-
cation factor within the same element. In the present paper, the circuit
is presented of such an amplifier, and problems are considered of the
synthesis of amplifier states with the use as active elements of the equi-
valents of a p-n-p-n structure with negative and close to zero output
dynamic resistance. A table is presented for comparison of the experimental
characteristics of amplifier stages fulfilled in this way. Amplifiers
fulfilled on the base of the equivalents of a p-n-p-n structure with a
controlled current CVC are able to have a large and satisfactorily stable
amplification factor. For measuring amplifiers -- as shown in the table
and in the literature -- it is preferable to use elements with a CVC of S-
type, tuned for zero dynamic resistance. Stabilization of the amplifica-
tion factor in a stage is accomplished within the same element by means
of a selection of the intensity of the positive and negative feedback.
Figures 3, tables 1, references 10: 9 Russian, 1 Japanese ? (in translation).

A MASER-CYCLOTRON-RESONANCE AMPLIFIER WITH FREQUENCY CONVERSION

YERGAKOV, V. S. and MOISEYEV, M. A.

/Abstract/ A three-resonator maser /sic/ with cyclotron resonance is con-
sidered whose resonators have generally different natural frequencies. The
first two resonators, where electron bunches are modulated, receive input
signals at frequencies close to the respective natural frequencies. The
third (output) resonator acts as an amplifier operating in the mode of

signals at frequencies close to the respective natural frequencies. The third (output) resonator acts as an amplifier operating in the mode of either forced oscillations or synchronized spontaneous oscillations, at the frequency of any one spectral component of the drift current. Optimum phase bunching of electrons is assumed to occur at small amplitudes of the field intensity in the first two resonators. The static magnetic field is assumed uniform along the entire length of the electrodynamic system. The equations of motion for electrons in the resonators and in the drift tubes are integrated analytically. The processes in the third (output) resonator are then evaluated numerically. The dispersion of electron velocities is assumed small and taken into account only in the determination of the trajectory angles of electrons in relatively long drift tubes. The electronic efficiency of maser-cyclotron-resonance amplifiers with frequency conversion is found comparable to that of a two-resonator amplifier, when close to or above synchronism. Their efficiency is found highest when the beam current is larger than the starting current of the output resonator, at synchronism. The authors are grateful to A. V. Gaponov and V. K. Vulpatov for discussion of their work. Figures 3; references: 10 Russian.

PARTICULARS OF DESIGNING VIDEO AMPLIFIERS WITH LARGE OVERLOAD CAPACITY

YANISHEVSKIY, A. A.

/Abstract/ The author considers the peculiarities of construction of pulse signal amplifiers that withstand overloading, and determines the conditions that obviate suppression of weak signals after strong pulse action for different design modifications. It is shown that in the case of short pulses the preferential design is an amplifier with indirect coupling circuits and inertial negative feedback. In other cases, the amplifier should be made with transfer circuits between stages and no transfer circuit at the input. With regard to number of stages and gain, the preferred amplifier is one with stages covered by inertial negative feedback. Figures 5; references: 2 Western.

CZECHOSLOVAKIA

HIGH-FREQUENCY AMPLIFIERS USING FET TRANSISTORS

ZALUD, VACLAV, engineer; Faculty of Electrical Engineering, Czech Technical University, Prague

/Abstract/ Two types of HF-amplifiers using FET transistors are discussed. The first type of amplifier uses a common intermediate point which in an optimized way combines the features of a common gate circuit with those of a common emitter circuit. The resulting amplifier shows a high gain, low noise, and good stability. The second type of amplifier is provided with an MOS two-gate transistor. This unit offers good stability and can be easily provided with an efficient gain control. These units are characterized by low distortions, mainly when the amplification is controlled. Figures 5; tables 1; references 5: 3 Czech, 1 Russian, 1 Western.

CZECHOSLOVAKIA

PRESENT TECHNOLOGY AND EXPECTED DEVELOPMENTS OF TRANSISTORIZED LOW-NOISE MICROWAVE AMPLIFIERS

TALLO, ANTON, engineer

[Abstract] Substantial improvements were recently achieved in the sphere of noise numbers and of limiting frequencies. Best noise properties are obtained with frequencies approaching 10 Ghz with simply refrigerated parametric amplifiers, and with masers. Some low-noise amplifiers are provided with octave frequency zones of amplifying. Such an amplifier has a hybrid circuit with an area of 15 to 17 square millimeters. All of the components of the circuit are produced by metal sputtering onto a dielectric support. Best results are obtained with MESFET transistors which indicate that transistorized microwave amplifiers may become universally used amplifiers in VVK zones. Figures 6; tables 3; references 12: 5 Czech; 2 Russian; 5 Western.

A PROCEDURE FOR CALCULATING THE SPECTRUM OF A TRAIN OF WIDTH MODULATED
PULSES

KULIKOV, G. M., and BAKHMUTSKIY, A. YE.

/Abstract/  A method is presented for precisely determining the spectrum
of an output signal, based on expanding the output signal function in a
trignometric Fourier series.  The determination in this fashion of the
spectrum of the width modulated pulse train requires a large volume of
computations which present no difficulty for digital computer calculation,
and in contrast to the dual Fourier series generally used for this purpose,
makes it possible to derive the amplitude-frequency and phase-frequency
spectrum with practically any degree of accuracy when the ratio of the
carrier and modulating frequencies is expressed by any rational fraction.
Figures 2; references: 7 Russian.

NOISE CHARACTERISTICS OF PARAMETRIC AMPLIFIERS BASED ON THIN FILMS OF A
NONLINEAR DIELECTRIC

VENDIK, O. G., KEYS, V. N., PRUDAN, A. M. and TER-MARTIROSYAN, L. T.

/Abstract/  A study was made to verify the theoretical relation between
the noise temperature in parametric amplifiers and their gain, at various
ratios of film thickness to acoustic wavelength.  Because the excess noise
is most significant in the degenerate mode of amplification, all measure-
ments were made in two single-stage parametric devices of the microstrip
structure, with strontium titanate as the active material, at the acoustic
signal frequencies 0.65 and 2.5 Hz respectively.  The results indicate that
the boundary conditions may be different in a real device than in the
theoretical model of an isotropic elastic medium with fixed constraints.
This is equivalent to a larger than theoretical effective acoustic thickness
of the film and should render the parametric regeneration of thermal acous-
tic vibrations less effective.  The experiment has thus confirmed that the
effective temperature of the excess gas in a ferroelectric film in a micro-
wave field is much lower when the thickness of the film becomes smaller than

half the acoustic wavelength.  This confirms, moreover, the correctness of the theory of thermal acoustic vibrations which is based on a parametric mechanism of heating.  It is feasible, therefore, to suppress the excess noise in parametric microwave amplifiers based on nonlinear dielectrics. Figures 2; references: 6 Russian.

CONCERNING THE INFLUENCE THAT POWER SUPPLY INTERFERENCE HAS ON THE NOISE FACTOR OF AN AMPLIFICATION STAGE

MAL'TSEV, P. P.

/Abstract/  An expression is found for the noise factor of an amplification stage as the ratio of the total noise power reduced to the input to that part of the noise power that is caused by the thermal noise of the signal source impedance.  The optimum signal source impedance is found that minimizes the noise factor for a given mode of bipolar transistor operation in an amplification stage.  It is shown that the interference voltage across the power supply terminals will have no effect on the optimum source impedance or the minimum noise factor if the square of the effective interference voltage reduced to the input is more than an order of magnitude less than the square of the effective value of the equivalent noise voltage. When the signal source impedance is lower than the optimum value, the noise factor may remain constant, or even decrease, if the collector current of the transistor is increased in the presence of a given interference voltage. Figures 2; references: 1 Russian.

USE OF FENCES FOR THE SUPPRESSION OF NEARLY SPECULAR GROUND REFLECTIONS

BATOROYEV, A. S. and KHOMYAK, YE. M.

/Abstract/ The ultrashort-wave field of a radiator is analyzed, taking into account the effect of the ground surface and the presence of fences on it. The reflection is assumed specular within a given range and the Fresnel laws of physical diffraction are applied to those fences. Both shape and size of such fences are optimized analytically, whereupon the results are compared with experimental data. Sectoral and toroidal fences are better reflection suppressors than rectangular fences, but then they are also more intricate and make the reflection coefficient more dependent on the refraction parameters. Figures 4, tables 1, references 6: 4 Russian, 2 Western.

THE FIELD OF AN ELECTRICAL DIPOLE IN A SEMICONDUCTING MEDIUM

DRABKIN, A. L. and KRASIL'NIKOVA, V. A.

/Abstract/ A formula is derived for the field intensity in the equatorial plane of an electrical dipole with a uniform current distribution, which is located in a semiconducting medium, such as sea water. The general formula for the field intensity is valid for any distance from the dipole; formulas are also given for the field in the medium close to the conductor, as well as at distances small in comparison with the wavelength in the medium, but commensurate with the dipole lengths. The limits to the application of the latter formulas are discussed and expressions are derived for the optimum dipole length and the maximum communications range. Figures 4, references: 3 Russian.

USSR                                                    UDC 621.396.67

SYNTHESIS OF AN ARRAY OF IMPEDANCE FILAMENTS

CHAPLIN, A. F. and MAKKAVEYEVA, V. F., Moscow Power Engineering Institute

/Abstract/ Linear arrays of impedance filaments to match a given radiation pattern with arbitrary excitation are synthesized by a method which reduces the problem to a system of quadratic equations and a subsequent

minimization of the $\emptyset = \sum_{m=1}^{n}(\mathrm{Re}\bar{Z}_m)^2$ functional according to either

Fletcher-Powell or Fletcher-Reeves. Such an array is assumed periodic, i.e., equidistant and the criterion for the solution is that the impedances must be reactive. When the minimum of the impedance functional is not zero, therefore, then corrective design measures and an analysis of the resulting radiation pattern become necessary. This method has been applied to typical arrays of 15 and 21 filaments, respectively, with not more than 2 percent discrepancy at interpolated points. Figures 2; tables 1; references 3: 2 Russian, 1 Western.


USSR                                                  UDC 621.396.67.01

AVERAGED BOUNDARY CONDITIONS ON THE SURFACE OF A FLAT WIRE GRID WITH NONORTHOGONAL CELLS

KONTOROVICH, M. I. and AKIMOV, V. P.

/Abstract/ The method of averaged boundary conditions is applied to the problem of electromagnetic wave diffraction by a flat grid of metal wires in which the cells take the form of an oblique parallelogram. It is assumed that the linear dimensions of the cells are small compared with a wavelength, and that the wires are ideally conductive and in ideal contact at intersection points of the grid. The current field of the conductors is calculated, and the averaged boundary conditions that are satisfied on the surface of such a grid are derived. The resultant expressions can be used to get formulas for the coefficients of reflection of a plane electromagnetic wave from an infinite grid in free space. Theoretical and experimental values of the modulus of the coefficient of reflection of an H-polarized plane electromagnetic wave from a flat grid with rhombic cells

are compared for different angles of incidence of the wave and different grid spacing relative to wavelength. The plane of incidence passes through the diagonal of a cell, so that the planes of polarization of the incident and reflected waves coincide. The calculated data agree well with the experimental values. Figures 3, tables 1, references: 7 Russian.

MUTUAL IMPEDANCE OF HALF-WAVE DIPOLE-REFLECTOR COMBINATIONS OF ARBITRARY LENGTH

BOLSUNOV, I. A. and STERIOPOLO, YE. A.

/Abstract/ The mutual impedance between half-wave and parasitic loaded dipoles is an important characteristic for calculation of multiband dipole arrays. The assumption of sinusoidal distribution of currents on both elements leads to considerable errors when these elements differ appreciably in length. In this paper the authors calculate the mutual impedance of a half-wave dipole-reflector combination, using more complicated distribution of the current along the passive dipole as proposed by Leontovich and Levin /see M. A. Leontovish, M. L. Levin, Zhurnal tekhnicheskoy fiziki, Vol 14, No 9, 1944/ based on approximate solution of the integral equation

$$I_2(z) = \; = \frac{1\omega \varepsilon 4\pi}{k\sin 2kl_2} \left\{ \sin k(l_2-z) \int_{-l_2}^{z} \left/ E^{CT}(z')-I_2(0)Z_H \right/ \sin k(l_2+z')dz' + \right.$$

$$\left. + \sin k(l_2+z) \int_{z}^{l_2} \left/ E^{CT}(z') = I_2(0)Z_H \right/ \sin k(l_2 - z')dz' \right\} ,$$

where $E^{CT}(z)$ is the spurious field excited by the parasitic element, $Z_H$ is the impedance of a load equivalent to the influence of the feeder, $l_2$ is the half-length of the element and k is the wave number. The results are given as graphs showing the resistive and reactive components of mutual impedance as functions of the distance between parallel elements for a reflector of constant length. The results show strong influence of dipole loading on mutual impedance up to the point where impedance changes sign. When the ratio of the length of the half-wave dipole to that of the reflector is greater than two, the sinusoidal approximation of current distribution becomes inapplicable. The results are experimentally confirmed. Figures 3; references: 4 Russian.

A CLOSE-MESH PHASE CORRECTOR

VERSHININA, L. N. and SIVOV, A. N.

/Abstract/ A phase converter in the form of a close mesh, with a period
smaller than the wavelength, is proposed here for applications in the
submillimeter range. It has a variable coverage factor and bends cylin-
drically so as to minimize reflection as well as absorption. Its charact-
eristics are calculated in the quasioptical approximation and assuming a
plane mesh with slowly varying parameters. Only the case of quadratic
phase correction is considered here, for simplicity, but edge effects are
taken into account. The focal length of such a "lens" system can be made
very short by placing several meshes very close to one another. A proto-
type phase corrector of this kind was compared with an equivalent cylin-
drical dielectric lens of the same focal length. The measured losses were
found to be comparable in both, but improvements in the mesh technology
can reduce the losses here further. Figures 2; references: 5 Russian.

MAXIMIZING THE INTEGRAL PARAMETERS OF ANTENNA ARRAYS BY SUPPRESSING LATERAL
EMISSION

MARTYNOV, M. A., PAVLYUK, V. A. and RYBALKO, A. M.

[Abstract] The problems of optimizing the integral parameters are very
important in the theory and practice of building emission systems; these
parameters include the directive gain, amplification factor and others which
characterize the directional properties of antennas. The authors propose a
method of optmizing the integral parameters of an antenna array which permits
them to reduce emission in suppression zones to a minimum level in addition
to producing a high level of directionality. The examples which they studied
demonstrated that it is feasible to employ the equation $(H+pA)x = e_0$ to find
the optimum flows using the method of dichotomy. From four to five iterations
are required in order to achieve an assigned level of suppression within 0.001.
Figures 3; references 3: 2 Russian, 1 Western.

INVESTIGATION OF THE SERVICE AREA OF A ZENITH ANTENNA

ZHIL'TSOV, A. U., NOVOSEL'TSEVA, G. V., SIMONOV, A. G., CHERNOV, YU. A., SHLYUGER, I. S., and EL'YASHEV, N. M.

/Abstract/ The lack of published data on the coverage of a territory by a Zenith antenna makes the design of a radiocommunication network very difficult. An experimental antenna of this type, with a gain on the order of 10 dB in a circularly polarized radiation field, was installed near Alma-Ata for the purpose of providing such data. A multielement turnstile antenna for Zenith radiation operating at 100 kW and 4565 kHz carrier frequency with "Beacon"-programmed modulation was installed on the transmitter side. Field intensities were measured at Fabrichnyy, Frunze, Dzhambul, Chimkent, and Taldy-Kurgan from 18 September to 6 October 1974 (in the most complex autumn period coinciding with minimum solar activity). Items of interest include the similar diurnal patterns at all these locations and the consistently depressed level of scattered signals, with an extra early-morning dip. Both measurements and calculations indicate that such a Zenith antenna has a range of 400-500 km during the day, and 1000-1200 km during the night in the absence of a "dead" zone. It should operate with ordinary-wave signals during the day and with extraordinary-wave signals at night. Such antennas are suitable for any region within the Soviet Union. The authors express their appreciation to T. K. Akopov, Ye. A. Gamor, G. M. Kuz'kin, Ye. K. Sagyndykov, and E. N. Revin for assistance in the work and discussion of the paper. Figures 5, tables 3, references: 2 Russian.

ON CALCULATING THE CHARACTERISTICS OF A PATTERN-SHAPING DEVICE

DOLZHENKOV, A. A., ZIMIN, D. B. and POLYANSKIY, M. YU.

/Abstract/ The pattern-shaping devices of receiving antenna arrays can be constructed as shown in the figure, where we see N radiators with amplifiers $I_n$, N power dividers $S_n$ for M channels each, NM phase shifters $\Phi$ in each channel, and M adders $R_m$ for N channels each, the terminals $F_m$ corresponding to M beams.
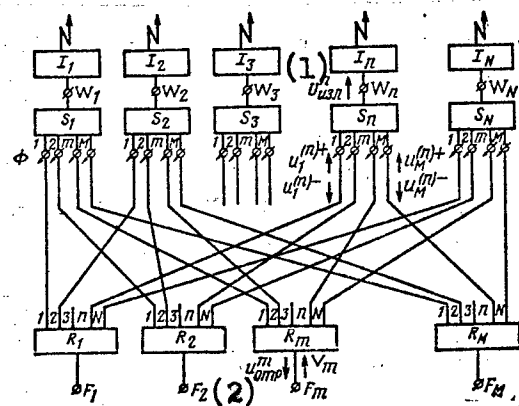
Figure 1

Key: (1) $U_{rad}^n$

(2) $U_{ref}^m$

Specific to such devices are distortions of the coverage pattern caused by the mutual coupling between internal channels which arise because of the finite decoupling between the terminals of the dividers and adders, and also because of reflections in the channels. Analysis of these distortions requires determination of certain coefficients of the scattering matrix of the pattern-shaping device. It is shown that when certain assumptions are made on the nature of the networks that make up the pattern-shaping device, the necessary coefficients of the scattering matrix can be found with relative ease and the coverage patterns calculated. Examples are given which show that pattern distortions can indeed be reduced by reducing the reflectivities of the dividers and increasing decoupling between their terminals. Figures 5, references 3: 2 Russian, 1 Western.

TIMOFEYEVA, A. A.

/Abstract/ Approximate analytical relations are derived and graphically represented for the geometrical design of biconical horns consisting of a strongly out-of-phase base horn and an almost in-phase small horn. The essential parameters include the flare diameters and the vertex angles of both horns as well as the location of the phase center. Such horn

radiators are useful for synthesizing nearly optimal radiation patterns of axisymmetric reflector antennas, designed classically or with a shift of the focal axis, or of antennas with an external radiator. They can also serve as feeders for parabolic horn antennas. Figures 12; references: 6 Russian.

MATCHING OF SECTORAL HORN RADIATORS

YAMPOL'SKIY, V. G.

/Abstract/ A simple and accurate diffraction method is proposed for matching of sectoral E-plane and H-plane horn radiators. The expressions for the reflection coefficient derived by this method are compared with those based on the conventional collocation method and are found to be satisfactory for design purposes. Figures 8, references 8: 5 Russian, 3 Western.

CZECHOSLOVAKIA

DETERMINATION OF RADIATION CHARACTERISTICS OF TRANSMITTER ANTENNAS USING
HELICOPTERS

BRADAC, JINDRICH, engineer

/Abstract/ Vertical flights by helicopters were used to measure systems of
planned television transmitting antennas at distances of two kilometers
from the transmitters; positions can be determined up to an angle of nine
degrees. The helicopters were also used for the determination of radiation
patterns, mainly vertical patterns of television transmitters. Suitable
instruments for indication and recording of the required values were car-
ried aboard the helicopters. Under favorable weather conditions average
values of the vertical diagrams may be determined; calculated transmitting
patterns may be checked by such actual measurements. Experimental values
show the shape of the transmission pattern, inclination of the maximum
radiation of the main bulge, the width of this bulge, locations of the
zeros, and their compensation. An evaluation of a large number of vertical
patterns recorded during vertical flights of a helicopter serves for the
evaluation of transmission of space patterns of a given system of antennas.
Figures 11; tables 2; references 3: 1 Czech, 2 Western.

EAST GERMANY

ANTENNA DISTRIBUTING SYSTEM AVV 01 FOR SHORT-WAVE RECEIVER INSTALLATIONS

FINCK, P.

/Abstract/ The newly developed AVV 01 antenna distributing system of the
state enterprise Funkwerk Koepenick consists of the short-wave antenna dis-
tributor AVV 01 K for the 1.6-30 MHz frequency range with 1 entry and 10
exits, the AVV 01 S antenna selector with 8 entries and 1 exit and a con-
troller for remote control and the power pack AVV 01 N for power supply.
These structural parts can be inserted into a 480x160x300 mm carrier. The
interaction of the parts of the AVV 01 system results from the picture
shown of a system for 3 antennas and 2 receivers. The prerequisites for
good reception through the intermediary of antenna distributors into the
signal route antenna-receiver are discussed. Technical data are presented
for the AVV 01 K short-wave antenna distributor, the AVV 01 S antenna selec-
tor and the AVV 01 N power supply. Figures 3.

Certain Aspects of Computer Hard and Soft Ware;
Control, Automation, and Machine Planning

EAST GERMANY

SOME TENDENCIES IN THE DEVELOPMENT AND APPLICATION OF MICROPROCESSORS AND MICROCOMPUTERS

MEILING, G., Dresden

/Abstract/ The general structure of a microcomputer, the characteristics
of some important types of microprocessors and the peculiarities of pro-
gramming compared with small-size computers are described. The use of
microcomputers for the control of instruments as an alternative to a wired
control-logic, for data covering and for decentralized information process-
ing is also considered. The structures of a microcomputer and of a micro-
processor are discussed by reference to their diagrammatic representations
and the programming possibilities, and the principal parameters of micro-
processors are analyzed. The advantages of microcomputers are compared
with small calculators and a prediction for the application of microcom-
puters in various fields is given for the year 1980. In particular, the
microcomputer will gain many fields of application where the use of firmly
programmed control units provides to little flexibility and where the
coupling with a small calculator is not realizable on technical or econom-
ical grounds. This report is from the Section of Physics, Technical
University, Dresden. Figures 4, tables 2, references 8: 4 German, 4 Western.

EAST GERMANY

A 1: COMPUTER STRUCTURES (STRUCTURES AND APPLICATIONS OF SMALL- AND MICRO-
COMPUTERS): ANALYTICAL DESCRIPTION AND EVALUATION OF A MODEL-COMPUTER
NETWORK

JACOB, H.-J. and LOEFFLER, H., Chamber of Technology

/Abstract/ A so-called model-computer network is used as a methodic
intermediate stage between the description with regard to the content of a
real computer network and a mathematical model. It is shown that the struc-
ture of the model-computer network can be built up from two elementary
structures by the graph G=/V, A/, where V is the quantity of all communica-
tion nodes and A is the quantity of logical transmission channels. A
theoretical communications activity description of the model-computer network

is presented and four effectiveness characteristics for the valuation of the method of its operation are suggested. The results of analytical and simulative tests on a model-computer network with a given structure are discussed on diagrams. Figures 4, tables 2, references 5: 4 German, 1 Western.

EAST GERMANY

MICROPROCESSORS. ELEMENTS OF FUTURE AUTOMATION TECHNIQUE

East Berlin RADIO FERNSEHEN ELEKTRONIK in German No 1, 1977 pp 5-7

REICHEL, RUDOLF, Dr. habil., professor

/Abstract/ Microprocessors are integrated central units of computers. They represent the provisional end point of the generation sequence of electronic computers, the principal development stages of which are shown in tabulated examples. The substance of a microprocessor is explained, the technical data of characteristic microprocessors are tabulated and the working principle of a microprocessor is discussed for normal operation and direct memory access by reference to diagrams. The structural elements of a microprocessor are shown to be mutually connected by the so-called data-bus, the address bus and the control bus which represent schematic summaries of electric interconnections for information transmission. The creation of special software development of the microprocessor is substantiated. The report is from the Institute for Simplication of Electrical Engineering/Electronics. Figures 2, tables 2.

EAST GERMANY

MAGNETIC BUBBLE MEMORY

East Berlin RADIO FERNSEHEN ELEKTRONIK in German No 3, 1977 pp 78-79

/Abstract/ Magnetic bubble memories represent a new method of memory technique with the help of which the density of stored data can be increased. The magnetic bubbles can be made from ferromagnetic materials in thin one-crystal layers. They represent cylindrically shaped zones which differ from their direct surrounding by an opposite magnetization. The characteristics of magnetic bubbles are reported by reference to their illustrated principle and to tabulated data of various mass memories. The controlled movement and the visualization of magnetic bubbles, their working principle and the development stage of their memories are discussed. The importance of magnetic bubble memories in telephony and their other operational possibilities is shown. Figures 1, tables 1, references 4: 3 German, 1 Western.

INVESTIGATION OF ASYMPTOTIC STABILITY OF NONLINEAR SYSTEMS WITH THE AID OF ROOT HOLOGRAPHS OF CONIC SECTIONS

RIMSKIY, G. V., Minsk Radio Engineering Institute

/Abstract/ In a previous work, the author proposed a root method of investigating asymptotic stability in a large nonlinear system of automatic control (NSAC) and determining the region of stability in spatial parameters. The method in question removed the limitations connected with selection of Lyapunov functions, and difficulties resulting from the necessary construction of the frequency characteristics of systems with variable parameters. The present work is concerned with a further development of this method by means of the introduction of new types of root holographs -- root holographs of conic sections -- and locating expressions with their aid which describes the boundaries of the region of asymptotic stability in the spatial parameters of the NSAC. The paper is recommended by the Department of Electronic Computers, Minsk Radio Engineering Institute. References: 4 Russian.

DESIGN OF A DELAY-MODEL REFERENCE ADAPTIVE SYSTEM

PHAM THUONG CAT, Research Institute for Computing Sciences of the Hungarian
Academy of Sciences

/Abstract/ A method for designing a hyperstable delay-model reference
system adaptive system is described. Earlier research was aimed at the
development of continuous and discrete systems, neglecting the delayed-
model reference adaptive systems; the present study takes care of this
omission. Circuits for parameter adaptation with differential compensation
and also with signal adaptation and linear compensation are presented. The
model may be also used for noise-free adaptive identification. The quality
control of the technique is illustrated by a computer simulation of a
noisy system. Figures 5, references 4: 2 Hungarian, 1 Russian, 1 Western.

ANALYSIS OF RELIABILITY OF STANDARD LOGIC ELEMENTS ACCORDING TO THE
CRITERION OF PROBABILITY OF ACCURATE SINGLE RESPONSE

TSIVINSKIY, A. S. and SHUBINSKIY, I. B.

/Abstract/ A method is proposed for evaluation of the reliability of
logic elements. The index of the accurate single response of a logic
element $\mathcal{P}_{LE}$ takes into account: the reliability of active radio components;
the determinable characteristics of the flow of malfunctions; the logic of
operation of the element; and the probability of entrance of the input
signals of the determine composition. The procedure for determining $\mathcal{P}_{LE}$
is outlined, formulas are obtained, and a graphic analysis of them is con-
ducted. Graphs are shown of the following: 1) Dependence of the reliability
of "OR" and "AND" elements on the number of inputs m and the probability q
of absence of malfunctions during entrance at the input of Code 1; and 2)
Dependence of the reliability of "OR" and "AND" elements on the probability
of entrance at the inputs of Codes 1 and 0. The proposed method makes it
possible to compare the reliability of the various structures of the logic
elements and to give recommendations with respect to the preferred (from
the point of view of increased reliability) method of encoding. Figures 2,
references: 2 Russian.

AN ALGORITHM FOR ORDERING WIRING AND SWITCHING CONNECTIONS FOR MULTILAYER
PRINTED CIRCUIT BOARDS

PETRENKO, A. I., TETEL'BAUM, A. YA., and ZABALUYEV, N. N.

/Abstract/ This paper deals with the problem of ordering connections when
routing multilayer printed circuit boards (MPP's) in which the unit for
additional junctions between layers is inaccessible. Routing of boards of
this type is done layer by layer and the connection between layers is
accomplished with contact plates designed for connecting the leads of com-
ponents. A description is given of an algorithm used in automating this
process which is intended to be used in conjunction with a topological

algorithm for routing connections described by the authors in an earlier
paper, thus making it possible to take the topological routing pattern into
account at the ordering stage. The algorithm described here takes into
account both the geometrical and topological properties of the circuit being
created. This algorithm has been proven feasible in solving practical
problems of MPP design. Experiments have demonstrated that topological
routing makes it possible to design MPP's which do not differ in the number
of layers, total length of printed conductors, and other characteristics
from MPP's developed manually. The algorithm described here for ordering
connections is implemented on the M-222 computer as part of the topological
routing program package described earlier. The MPP is modeled in such a
way that ordering of wiring and switching connections takes place in the
form of a hypergraph the vertices of one axis of which interpret the
board's contact plate. The first step in the algorithm divides the set of
these vertices into a subset of vertices corresponding to connection com-
ponents, which are formed from forbidding edges and these vertices. Each
electrical circuit is then divided into connections. Then a tree of connec-
tion component links is formed. The set of connections is divided into
two groups and is ordered. Finally, routing of the first group of connec-
tions, and then of the second takes place. Then steps two to five are
repeated for the next layer. Topological properties are taken into
account in the program by dividing the connections into two groups. Several
theoretical aspects of the ordering algorithm described are discussed and
these notions are applied to a discussion of the feasibility of an ordering
algorithm for layer-by-layer routing of printed circuit boards with elements
based on integrated circuits, in which there are a considerable number of
leads placed very close together. Several theorems are advanced on the
basis of the notions developed here. Figures 2, references: 2 Russian.

KARELIN, VLADIMIR PETROVICH, candidate of technical sciences, TRTI /Taganrog
Engineering Institute/, Taganrog, and KALASHNIKOV, VALERIY ANATOL'YEVICH,
candidate of technical sciences, TRTI, Taganrog

/Abstract/ This paper deals with problems in optimizing the design of
circuit boards with wiring (harnesses). The basic optimization criteria
are the following: At the layout stage it is necessary to achieve a layout
of components with which the total length of connections will be as small
as possible, or close to it. At the routing stage it is necessary to find

a way of routing connections between components so that the diameter of the harness will not exceed the maximum permissible. In addition, there are restrictions on where to put the harness on the board. These restrictions, along with restrictions on the diameter of the harness, have a substantial influence on component layout. It is suggested here that the overall wiring problem be solved by performing a series of procedures in sequence. Formal algorithms are suggested which optimize the results obtained at the preceding step with respect to a given criterion. A circuit board is thought of as a set of X and Y coordinates, on which modules are laid out at intersections of coordinates. Harnesses are run along two vertical and p horizontal coordinates, each of the p horizontal harness lines serving components of a corresponding horizontal row. Harnesses consisting of wires connecting components of different rows are run along vertical trunks. In the wiring variant discussed in this paper the vertical harnesses are laid out along the edges of the board. Components with contact-type terminals are connected by means of these vertical harnesses. The most important step from the viewpoint of an optimum final result is determining the optimum layout of components on the board, for this has a direct effect on the total length of connections and on the diameter of the harnesses. An algorithm for finding the optimum layout of components is based on a table of paired connections between leads of individual components and between leads of components and contact terminal leads. As a result of studying this table a circuit matrix is mapped out. The sequence of procedures for optimum component layout is detailed. The circuit is broken down into subcircuits consisting of a certain number of components, with the division criterion being the minimum number of connections between these subcircuits. A final determination is made of the optimum linear layout of components of each of the subcircuits arrived at at the first step in the process. Algorithms described in earlier papers are used to perform some of the steps in the procedure described here. A description is also given of the algorithm for linear layout of components in horizontal rows, which is a sequence of two separate algorithms, which are described in detail. Several variants are possible for routing connections along trunks, and ways of determining the best variant are described. Optimization when performing each layout procedure improves the solution arrived at in previous steps, with the use of sufficiently simple algorithms for intersection and linear allocation of graph coordinates. The final result observes all restrictions. Programs for the BESM-4, written in ALGOL, have been compiled for this system of algorithms. Figures 3, references: 3 Russian.

USSR                                                    UDC 621.391.2

# DIGITAL MODELING OF GAUSSIAN RANDOM PROCESSES AND FIELDS

KHUDYAKOV, G. I.

[Abstract]  The author investigates new methods of computer modeling of
Gaussian random functions with zero and arbitrary self-correlation functions;
an analysis is made of their accuracy and examples are given for modeling
stationary random processes.  The choice of a method of digital modeling of
a random function depends both on the form of its self-correlation function
and on the given accuracy of modeling and several other requirements such as
the retention of ergodicity, the possibility of continuing the processes,
etc.  The author makes a comparative analysis of the effectiveness of modeling
by one or another method in each specific case on the basis of the properties
and evaluations of modeling accuracy examined in the article.  The author
thanks V. V. Nadysev for assistance in computing work. Figures 2, references:
6 Russian.

USSR                                                    UDC 621.396.965

# A DIGITAL SYSTEM OF CONTROLLING A LASER-MIRROR SCANNING DEVICE

VYSKUB, V. G., GALUYEV, S. V., MAMAYEV, V. L., ROZOV, B. S., SAVEL'EV, V.I.
and SABOSTIN, P. I., Moscow Engineering-Physics Institute

/Abstract/  A high-precision digital system for controlling an optico-
mechanical scanner with interferometry of angular displacements is des-
cribed.  The nonlinear stabilization algorithm uses only information about
the position error and the velocity sign.  Large displacements are effected
in accordance with the "acceleration-deceleration" principle.  The system
includes an amplifier, the target, an encoder, a synchronizer, a reversible
counter, a digital comparator, and a zone decoder.  The stabilization zone
must be wider than the amplitude of spontaneous oscillations, but also
narrow enough to ensure short transients over a wide range of displacements.
The system was tested with one-mirror two-coordinate scanners and is expected
to perform even better with a more "rigid" two-mirror scanner.  This paper
is recommended by the Department of Automatics and Telemechanics, Moscow
Engineering-Physics Institute.  Figures 1, references: 2 Russian.

QUESTIONS IN THE CREATION OF A DATA BANK FOR THE FUNCTIONAL SUBSYSTEMS OF
THE COMMUNICATIONS AUTOMATED MANAGEMENT SYSTEM

VERKHOVSKIY, L. I. and SOLOMATINA, S. A.

/Abstract/ The Communications ASU /Automated Management System/ is a
hierarchical system consisting of three components: Organizational, func-
tional and support elements. The functional component, in addition to the
technological systems, incorporates the functional and industrial sub-
systems. The functions and composition of the software for integrated
data processing systems are treated, as well as one of the possible vari-
ants of the structure of the data base for a data bank of two functional
subsystems of the Communications ASU at the Union level: "Engineering and
economic planning, and economic activity analysis" ("Plan") and "Planning,
labor and payscale analysis and accounting" ("Trud"). The data processing
software, structure of the data base and the breakdowns of the "Plan" and
"Trud" subsystems are illustrated by means of flowcharts. The proposed
approach to the development of the software and the structure of the data
base can find applications in the construction of a data bank not just for
the "Plan" and "Trud" functional subsystems at the Union level, but also
for other subsystems and levels of the communications ASU. Figures 3,
references: 6 Russian.

SYNTHESIS OF RING ENCODERS OF THE FOURTH KIND WITH A PRESCRIBED MINIMUM
STACK LENGTH

SHARIN, YU. S. and MIRONENKO, A. A., Ural Polytechnical Institute

/Abstract/ Encoders of the fourth kind are synthesized with the aid of the
(tXn)-matrix representing a rationalized gear train of possible one-track
scales, t denoting the number of stacks (segments of a one-track scale
containing g adjacent quanta of the same quality) and n denoting the length
of code combinations. This method is applied here to the optimum synthesis
of such encoders, requiring the smallest possible number of the longest
possible stacks. The object is to distribute the stacks over the (tXn)-
matrix so that in the rows will appear code combinations which belong in

complete classes and no code combinations which belong in one class. The procedure is shown here step-by-step and is illustrated by a specific example of an angle-to-code converter physically realizable in the form of an electrolytic device. This paper is recommended by the Department of Semiconductor and Electrovacuum Machine Building. Figures 4, references: 6 Russian.

SYNCHRONIZATION OF AN M-SEQUENCE GENERATOR USING MODIFIED METHODS OF SEQUENTIAL ANALYSIS

LOSEV, V. V.

/Abstract/ The author examines methods of synchronization based on utilization of the structural properties of sequences of maximum length. He determines the parameters which characterize the effectiveness of these methods. He finds that the effectiveness of this method of sequential analysis can be significantly raised if certain structural properties of the M-sequence are employed. The author derives equations for this analysis and gives a brief description. The author thanks Yu. V. Tronin for attentive reading of the manuscript and for his remarks. Figure 1, tables 1, references: 6 Russian.

A SPECIAL-PURPOSE CRYOTRONIC PIPELINE UNIT

LUTSKIY, GEORGIY MIKHAYLOVICH, candidate of technical sciences, KPI /Kiev Polytechnic Institute/, Kiev; and YANKOV, KRASIMIR IVANOV, graduate student, KPI, Kiev

/Abstract/ Development of faster high-performance computers by increasing the execution rate of logic elements has nearly exhausted its possibilities, because of the finite speed of signal propagation, which results in the fact that delays in the passage of signals through connecting conductors are

commensurate with the time required to switch logic elements. Film and semiconductor integrated circuits make it possible to reduce the length of conductors and delays in connecting conductors, but the structure of logic units designed for integrated execution is subservient to the specifications imposed by the technological features of the structure of integrated circuits, and these specifications are not compatible with the principles for designing high-speed data processing equipment. One of the ways to get around this which seems promising is to use a network structure of identical elements interconnected by connections of minimum length. But here, too, solving the problem of reducing the number of external leads is usually accomplished at the expense of the overall speed of the computing equipment. These considerations have created great interest in parallel processing, but many problems are of a sequential nature and do not permit parallel processing. This paper deals with one possible approach to designing high-performance hardware which will efficiently solve both types of problems. This approach utilizes the pipeline method of data processing, which makes it possible to observe the basic specifications imposed by cryotrons. A study is made here of application of this approach to designing a special-purpose cryoelectronic unit which will perform a specific polynomial computing operation added to the machine language. The modes of executing steps in the computation process are totally compatible with the specifications imposed by the cryoelectronic technology employed. A description is given of the structure of pipeline data converters, which are multilevel structures in which each i-th level contains a certain set of registers and a certain set of control flip-flops, with specific relationships between the states of registers and flip-flops at certain moments of time. In this particular application the pipeline unit makes possible simultaneous processing of a set of independent program sequences. Computation of the polynom is performed as a sequence of multiplication, division, addition, and subtraction operations added to the machine language. Implementation of a pipeline unit utilizing cryoelectronic elements and designed to perform computing operations of the specific type described here is described in detail. Schematic diagrams are shown. High processing speed is made possible by the fact that it is possible to realize coincidence among programs, among operations, and within programs and within operations, at the same time. For performing operations to compute the formula given here (n + q) machine cycles are required, where n is the length of the words to be processed and q is the degree of the polynomial to be computed. Figures 3.

# UNIVERSAL LOGIC MODULES AND THEIR APPLICATION

MAYOROV, SERGEY ALEKSANDROVICH, doctor of technical sciences, LITMO
/Leningrad Institute of Precision Mechanics and Optics/, Leningrad;
SKORUBSKIY, VLADIMIR IVANOVICH, candidate of technical sciences, LITMO,
Leningrad; and KRAVTSOV, LEONID YAKOVLEVICH, engineer, GSKTB /State
Special Design and Technology Bureau/ for Designing Calculating Machines,
Leningrad

/Abstract/ Universal logic modules (ULM's) make it possible to design a
wide range of non-regular computer circuits with a minimum number of
modules. This paper deals with the application capabilities and properties
of ULM's. The structure of ULM's makes it possible to realize any logic
function with a specific number of arguments in a single package by select-
ing which leads are to be used. The ULM most widely used has the structure
of a two-level non-iterated logic circuit which realizes a Boolean func-
tion in disjunctive normal form. Curves are given showing the relation-
ship between the number of leads in a ULM and the number of arguments.
These curves show that the number of leads in a non-iterative ULM is con-
siderably less than in other types of ULM's, thus accounting for their
wider use. After a discussion of structure in terms of number of leads,
logic functions and subfunctions, and arguments, the application of several
ULM's to realize a randomly chosen logic function is dealt with. Formulas
are derived for finding the upper and lower limit of the number of possible
modules in a specific circuit, taking into account the number of module
leads and the number of circuit inputs. An example is given of how it is
possible to design an optimum schematic diagram to realize a specific system
of logic functions using ULM's to cover the entire circuit. This process
involves a great deal of sorting, but an approximate solution can be
arrived at by covering with modules a logic circuit with a simple Boolean
basis (AND, OR, NOT) obtained by structural methods described in an earlier
study. In covering the circuit an attempt is made to reduce the number of
module packages in the circuit, taking the upper limit into account. This
process begins with selecting those outputs of logic elements which must
be outputs of ULM's. The circuit is then broken down into a set of sub-
circuits. The concept of a "library" of subfunctions performed by sub-
circuits is introduced, and this library is expanded or diminished depend-
ing on frequency of use of a specific subfunction and/or economic considera-
tions. ULM's are quite adaptable for realizing complex Boolean functions,
such as those encountered in signal coding circuits and in circuits of
microprogram automatic devices. In designing basic circuits by the circuit
coverage method the best modules to use are those obtained by mechanically
combining non-iterated ULM's in a package with a specific number of leads.

An example is given of the procedure for designing a basic circuit for performing a specific system of logic functions, using ULM's, with emphasis on optimality and the use of a minimum number of modules. Figures 7, references 4: 2 Russian, 2 Western.

CHOICE OF OPTIMUM PARAMETERS OF DECODING RC-FILTERS FOR PSEUDO-RANDOM PULSE COMPUTERS

YERUKHIMOVICH, VIKTOR MIKHAYLOVICH, chief designer_SKTBE /expansion unknown; probably a Special Design and Technological Office/ (Khar'kov)

/Abstract/ Low-frequency filters are useful as simple decoders where pulse sequences must be converted to analog signals. The parameters of such a filter are optimized here for application in pseudo-random pulse computers, where periodic pseudo-random sequences are generated by a shift register with linear feedback. The process at the filter input is characterized by a mathematical expectation and a dispersion. The process at the filter output is found to be a biased estimator of the machine variable, with some maximum bias and a dispersion. Both processes are assumed stationary and, on the basis of a definite relation between the given machine variable and fluctuations of the output process, the maximum mean-squared error of decoding with this machine variable is calculated for a 0.997 confidence level. Tables 1; references 5: 3 Russian, 2 Western.

PHASE-PULSE DISPLAY USING SEMISEGMENTAL INDICATORS

ZHELUDOV, V. M., chief designer, Design Office, Main Administration of Signalization and Communication, Ministry of Railroads

/Abstract/ The phase-pulse method of data display combines the advantages of dynamic readout with a brightness not dependent on the number of characters and with its realizability in terms of simple discrete logic circuits. Discrete digital data are determined on the basis of the carrier

location along a linear time scale. The principle of such a counter is analyzed here on a space-digital axis for modulus N denoting the basis of any given counting system as, in this particular case, 10 in the decimal system. The circuit consists of a number generator, a 1-2-4-8 code register, a segmental decoder, and a segmental indicator consisting of luminescent vacuum tubes connected in parallel. The optical inertia of ignition and extinction processes in these lamps operating in the pulse mode produces the effect of a static display. With its excellent information indicating and storing characteristics, this device may find many applications. Figures 5.

EAST GERMANY

THE CONSUMER GOODS ELECTRONICS OF THE SOVIET UNION IN THE 10TH FIVE-YEAR PLAN. PART 1: TELEVISION

GOROCHOWSKI, A., engineer, chief editor of the journal Radio, Moscow

[Abstract] Developments of the television network and of television set production in the USSR are reviewed. There were nearly 60 million television receivers and 1850 television transmitters at the beginning of the year 1976 with the number of receivers increasing from 1 million in the year 1955 to 60 million in the year 1975. The first direct transmission over the networks "Intervision" and "Euravision" took place on 14 April 1961 (Gagarin in Moscow). During the 10th Five-Year Plan, the number of ground stations will be increased from 68 at the end of 1975 by 20 stations of the Orbita system. The newly-developed universal Mars-2 station can operate on circular and elliptical orbits. The development of regular color television broadcasts, the automatic television station ATRS-5/1, and the new station Ilmen are discussed. More transistors and integrated circuits are continuously being used in television receivers and there is a transition from mechanical to electronic control systems. The principal tasks which have to be solved in the 10th Five-Year Plan were formulated at the 25th party rally of the Communist Party of the Soviet Union. Figures: 6.

CZECHOSLOVAKIA

ON THE PROBLEM OF FULL COVERAGE OF CZECHOSLOVAKIAN TERRITORY BY TV SIGNALS

KLACEK, JAN, engineer

[Abstract] The ideal coverage of Czechoslovakian territory should be 100 percent. However, the costs of such an undertaking would be extremely high. The financial and technical problems of areas which are thinly inhabited or cover rugged terrain are substantial. Czechoslovakia uses two networks: Network I operates transmitters of 10 KW and above; Network II, transmitters with 20 KW and above. Some local stations of Network I operate with only 2.5 KW, and of Network II with only 5 KW. The greatest problem in covering the mountainous areas of the border regions is the necessity for avoiding interference with television transmission in neighboring countries. Such areas can be best serviced by cable television. Some improvements of the present conditions may be expected when satellites are used for transmission of TV programs. Other technical progress in transmission technology will also improve the situation. References: 3 Czech.

STEREOCOLOR VIDEO CONTROL DEVICE

BIRYUK, V. N., ZHDANOV, S. I., KOLIN, K. T., MOROZOV, V. A., NAVOLOTSKIY, YU. A., TSERETELI, V. G. and SHUMLYAYEV, V. S. Leningrad Electrotechnical Institute of Communications imeni M. A. Bonch-Bruyevich /LEIS/

/Abstract/ A stereocolor video control device (STsVKU), created at the Television Department of LEIS, has the possibility of operation in single-channel and double-channel regimes. A polarizing method of stereo images separation is used, which assures a high quality of the stereoscopic color television image during group observation. A model of the STsVKU was used in experimental investigations of the effect of the parameters of the video signal on the quality of the stereocolor image. The investigation was conducted at LEIS together with MNITI /? Moscow Scientific-Research Technological Institute/ Figures 6, references: 7 Russian.

PRECISION POLYGONAL MIRRORS IN OPTICAL-MECHANICAL SCANS

BENEDICHUK, I. V., and IVANOV, YU. S. All-Union Scientific-Research Institute of Television and Radio Broadcasting

/Abstract/ Problems are considered which originate during the design of one of the most critical units of an optical-mechanical scanning device-- the precision polygonal mirrors. A method is proposed for determining the geometrical dimensions of a polygonal mirror which makes it possible to perform engineering calculations of a mirror for optical-mechanical scan, taking into account a specified resolution, the number of faces and the duration of the return time of scanning. It is proposed to conduct a calculation of the voltages which originate in the rotating polygonal mirror, if the number of faces is greater than 15, making use of the dependences obtained for the body of revolution. The requirements on the precision of production of the polygonal mirrors considered in the work make it possible to fulfill a calculation of the allowances for production. It is shown that the proposed technology of production of the polygonal mirrors makes it possible to produce a mirror with any number of faces for systems of recording, read-out and reproduction of information. Photographs are shown of a device of processing of polygonal mirrors and an experimental high-speed electric motor with a polygonal mirror. Figures 8, references 11: 5 Russian, 6 Western.

USSR                                    UDC 621.397.6.014.2.049.77

VIDEOCOMMUTATOR

KRASOVSKIY, V. A., VOYTYANOV, E. M., BEZUSHKO, V. A., ANDRUSENKO, V. V., GOZBENKO, V. P. and SMIRNOV, L. V., Kirovograd Radio Products Plant

[Abstract]  An integrated-circuit multichannel videocommutator is analyzed. The commutator can receive 32 video signals from input jacks and feeds them to four blocks of input amplifiers.  Each input amplifier block has eight amplifiers.  From the output of each input amplifier block eight video signals are sent to 11 blocks of an 8 x 1 commutator.  Cross-interference is obtained above 60 dB, measured at the frequency 4.4 MHz, when in-phase signals are fed to all inputs but one and when these signals are picked up at all inputs but one.  Figures 2.

SYNCHRONY IN PHASED AFC AND TANK CIRCUITS UNDER THE ACTION OF PERIODIC
PHASE-SHIFT KEYED SIGNALS

TERYAYEV, B. G.

/Abstract/ The author considers two-channel systems using two phase-shift
telegraph signals in quadrature, each with a keying angle of 0-180°, the
signal in the in-phase channel being much stronger than that in the quadra-
ture channel. Detection is by a reference signal shaper such as that shown
in the block diagram, where ФДМ is the phase-shift demodulator, ФЗ is a
filtering element (phased AFC or tank circuit) and ФД, is the phase
detector.
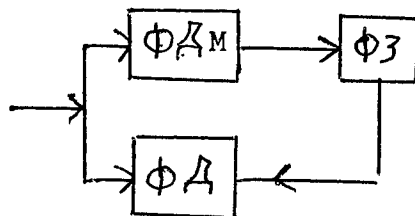


Limits of synchrony are determined for a small keying angle $\phi_0$ and periodic
phase motion. It is found that such a system is always in synchrony if there
is no frequency mismatch in the reference signal shaper. The region of
synchrony decreases when frequency mismatch is present, although the peak-
to-peak phase separation $\alpha$ in the phased AFC circuit is always less than $\phi_0$.
In tank circuits when frequency mismatch is high, $\alpha$ increases to $\pm \pi$ at the
limit of synchrony, and may be much greater than $\phi_0$. Because this reduces
the interference immunity of the communication line, such systems should be
phased AFC circuits as the filtering element in the reference voltage
channel when frequency instability is appreciable. Figures 7; references:
9 Russian.

CORRELATION FUNCTION AND ENERGY SPECTRUM OF THE PHASE DERIVATIVE OF A
FREQUENCY MODULATED SIGNAL AND ADDITIVE GAUSSIAN NOISE

RABINOVICH, M. A.

/Abstract/ An expression is found for the correlation function of the phase
derivative of the sum of a frequency modulated signal and gaussian noise
For a modulating signal of the mismatch type, graphs are given of the
energy spectrum of the phase derivative that are plotted by a numerical
integration technique. A comparison of the exact and approximate values of
the energy spectrum for zero frequency shows that an asymptotic formula
can be used

$$W(0) \approx 8\pi^2 \left\{ (r^2 + \Delta f^2)^{1/2} < 1 - \mathrm{erf} \left[ \rho + \rho \frac{\Delta f^2}{r} \right]^{1/2} > \right.$$

$$\left. + \Delta f \, e^{-\rho} \, \mathrm{erf} \left[ \rho \left( \frac{\Delta F}{r} \right)^2 \right]^{1/2} \right. \text{ as } \rho \to \infty$$

when $\rho > 2$ and $|\Delta f| > 0.5\, r$ ($\Delta f$ is the frequency mismatch and r is the
rms frequency band of the gaussian input noise). Figures 4, tables 1,
references 5: 3 Russian, 2 Western.

SIGNAL DETECTION IN THE PRESENCE OF NOISE-FREQUENCY-MODULATED INTERFERENCE

GONOPOL'SKIY, V. B. and VALAYEV, V. G.

[Abstract] A system is shown for the detection of signals appearing with
noise-frequency modulated jamming interference by means of standard protected
channels. Each of the two channels here constitutes a Gaussian receiver GR
immune to inherent noise and protected at the input by an inertialess nonlinear
suppressor NS as well as (or) by a noise whitening filter WF. A weighting
element is added behind one of the channels. The performance of such a system
is analyzed, with the input interference having a modulated component $x_m(t) =$
$A_0 \cos \omega_0 t + \emptyset(t) + \emptyset$ [random phase $\emptyset$, modulated phase $\emptyset(t) = k \int_0^t \xi(t) dt$, nonwhite

noise $\xi(t)$/ to which a white noise n(t) has been added. An evaluation of various designs in the worst case ( $\omega_0$ = 0) indicates that a series NS-WF-GR channel in parallel with a series WF-GR channel is most effective, with only a slight tradeoff for simpler series NS-GR channels. Figures 3, references: 8 Russian.

DELAY SYNCHRONIZATION OF A CORRELATIONAL RECEIVER WITH COMPLEMENTARY SERIES AT THE INPUT

KLYUYEV, L. L.

/Abstract/ Manipulating noisy sequences with messages increases the error of a correlation tracking device. The use of complementary series not only eliminates this drawback but also enhances the noise immunity of the information transmitting channel. Such a complementary series is shown here in the form of contiguous D-sequences whose odd elements coincide and whose even elements do not. A reference generator reproduces these sequences and feeds them to the information retrieving stage, which includes a correlator and a threshold device, as well as to the delay tracking stage. Feedback between both stages can thus be eliminated and the delay fluctuations of the reference noisy signal reduced. A noisy signal is synchronized, i.e., the indeterminacy of its delay is removed by means of an autocorrelational receiver. Such a receiver without the delay line, as proposed here, is equal in performance to the Ward receiver and, when searching in the presence of fluctuation noise even operates faster. Figures 2, tables 1, references 6: 5 Russian, 1 Western.

STATISTICAL CHARACTERISTICS OF SIGNALS WITH ATMOSPHERIC NOISE IN THE HIGH-FREQUENCY RANGE

RUBTSOV, V. D.

[Abstract]  A model of atmospheric noise is proposed here which ensures close agreement with experimental data for the high-frequency range.  The noise entering a narrow-band receiver is described as

$$\zeta(t) = \rho(t)\cos[\omega_0 t - \varphi(t)]$$

where the noise envelope o(t) has the distribution

$$W(\rho) = 3\sigma^3 \rho / (\sigma^2 + \rho^2)^{5/2}$$

independent of the phase  (t) uniformly distributed on the $[-\pi, \pi]$ interval. The statistical characteristic of such a noise mixed with a narrow-band signal

$$s(t) = A_s(t)\cos[\omega_0 t - \varphi_s(t)]$$

are analyzed here and the quality of the optimum receiver for extracting a signal from non-Gaussian noise is evaluated.  Such a receiver consists of a nonlinear element with the characteristic

$$f(\zeta) = -d\ln W(\zeta)/d\zeta$$

and a linear receiver which is optimum in the case of Gaussian noise. Figures 5, references 4:  2 Russian; 2 Western.

FAST-SEARCH SEQUENCES WITH AN ARBITRARY BASE

LOSEV, V. V. and KARYAKIN, YU. D.

[Abstract] Fast-search sequences are constructed which constitute an extension of the binary case but, unlike Stiffler sequences, are given in terms of a function defined in the set of substitution cycles for numbers $0, 1, \ldots, N-2$. The search is effected by calculation of the functions which describe the correlation between the received signal and generalized meanders. On the basis of this principle, many effective sequences with additional useful properties are possible for any q and n. This is demonstrated here on integers q and n equal to or larger than 2, with $N = q^n$ and $m = N-1$, where substitution V is defined as $V: \omega \rightarrow q\omega \bmod m$ ($\omega$ assuming values $0, 1, \ldots, m-1$). Periodic fast-search sequences A of length $N = q^n$ are established, the problem of determining the correlation coefficients, on which the mean search time depends, is discussed, and the probability of error in every phasing step is evaluated. Tables 1, references 5: 4 Russian, 1 Western.

RELATION BETWEEN INDETERMINACIES FOR A RADIO CHANNEL WITH RANDOM PARAMETERS

GAVRILIN, A. T.

[Abstract] A receiver is considered into which enters an additive mixture

$$x(t) = y(t, \alpha) + n(t)$$

of a random not necessarily Gaussian signal $y(t, \alpha)$ depending on some constant on the interval $[0, T]$ parameter $\alpha$ and a white normal noise $n(t)$ with a bilateral spectral density $N_0$. Both processes are assumed statistically independent, $y(t, \alpha)$ having continuous relaizations and its average over the process distributions at a fixed $\alpha$ being $E_\alpha \{y^2(t, \alpha)\} < \infty$. It is proved that a stable optimum mean-square algorithm of signal $y(t, o)$ filtration and a very accurate estimate of parameter o from the $x_0^T \equiv \{x(\tau), 0 \le \tau < T\}$ realization are mutually exclusive requirements. This is illustrated in estimating, as an example, the amplitude parameter of a signal in a channel with attenuations. References 8: 4 Russian, 3 Western.

UDC 621.391.2

# INTERPOLATION AT A POINT IN A DISCRETE MARKOV PROCESS

KUL'MAN, N. K. and KHAMETOV, V. M.

/Abstract/ The problem of simultaneous filtration and interpolation at a point is solved here for a discrete Markov process with known initial probabilities and an infinitesimal operator. The equations for á posteriori probabilities and estimates are constructed so as to allow for two kinds of estimate: a continuous one which is optimum with respect to minimum mean-square error and a discrete one which yields the minimum error probability. Nonlinear algorithms are constructed in symmetric form for a binary process, suitable for synthesis of nonlinear digital and analog filter-interpolators. On the theory of Gaussian Markov processes and by the optimum linear transformation corresponding to given correlation functions, linear algorithms are then constructed suitable for synthesis of linear analog and digital filter-interpolators. References: 5 Russian.

UDC 621.391.2

# APPLICATION OF INTEGER PROGRAMMING TO PROBLEMS OF OPTIMIZING AN INDETERMINACY FUNCTION

ABRAMOVICH, YU. I., DANILOV, B. G. and MELESHKEVICH, A. N.

/Abstract/ Discrete and "continuous" nonconcave problems relating to the optimization of a reciprocal indeterminacy function can be reduced to the canonical form of linear integer programming. The synthesis of discrete signals, applicable to radar and coupled systems where side lobes must be minimized within a given range in order to ensure a high resolution, is an example of problems in the first class. The synthesis of linear filters optimizing, with respect to some criterion, the response to signals of a given form is an example of problems in the second class. The authors express deep appreciation to M. B. Sverdlik for helpful discussion of the results of the news. References 16: 9 Russian, 5 Western.

USE OF WEIGHTING TO RESOLVE COMPLEX SIGNALS MASKED BY UNSTEADY INTERFERING REFLECTIONS

ABRAMOVICH, YU. I. and ZAYTSEV, S. A.

/Abstract/ The authors consider the problem of determining the number and coordinates of targets masked by clutter. Interfering reflections are modeled by a gaussian process with correlation function that is uniquely defined by the known range-velocity distribution of interfering reflections. Poisson distribution is assumed for the flux intensity of the complex signals reflected from the useful targets. A quasi-optimum algorithm is found for solving the problem of coherent processing of output signals of a limited number of channels in which the interfering reflections are eliminated. An example is given showing that an increase in the number of processing channels enables resolution of targets in clutter with completely acceptable losses of signal-to-noise ratio. In conclusion the authors thank M. V. Sverdlik and A. G. Ponomarev for constructive criticism. Figures 2, references: 7 Russian.

ADAPTATION OF THE SEQUENTIAL RANK DETECTION PROCEDURE

AKIMOV, P. S. and YEFREMOV, V. S.

/Abstract/ Nonparametric (rank) processing ensures a distribution of test statistics which, in the absence of a signal ($H_0$ hypothesis), is invariant with respect to form and distribution parameters of the noise. An algorithm is developed for sequential detection on the basis of a nonoptimal but conveniently computatle statistic, with summation of ranks, and the structure of a detector implementing this algorithm is shown. Figures 2, references 7: 6 Russian, 1 Western.

DETECTION OF AN INCOMPLETELY KNOWN SIGNAL BY THE METHOD OF MAXIMUM LIKELIHOOD

ALEYNER, R. SH.

/Abstract/ The author considers the problem of synthesizing a detector for a useful deterministic signal against a background of interference in the case of inexact data on the useful signal. It is assumed that the shape of the received signal is incompletely defined; it is known only that the signal shape differs from that of a known reference standard with respect to some norm by no more than a fixed constant. The specific definition of the norm is given. The signal amplitude is unknown, the nondegenerate correlation matrix of normal noise is assumed to be completely known, and the average noise is equal to zero. The method of maximum likelihood is used to find a resolving rule for detection of such a signal, and it is shown that the resultant detector is stable relative to variations in the shape of the useful waveform. The author thanks V. P. Kuznetsov for constructive criticism. Figures 1, references: 9 Russian.

SYNTHESIS OF ALGORITHMS FOR OPTIMAL PROCESSING OF LIGHT FIELDS

BAKUT, P. A., SVIRIDOV, K. N., TROITSKIY, I. N., and USTINOV, P. D.

/Abstract/ The processing of light fields in a turbulent atmosphere is considered in the case of a large signal-to-noise ratio, and a functional is obtained which characterizes the probability density of such a field of a remote point source. The optimal operations for processing such fields are a construction of two double integrals and a subsequent maximization of their sum with respect to the unknown distance from the angular coordinates of the source. The physical significance of these two double integrals is discussed further, and the appearance of a "phase" term in the probability functional is attributed to the large signal-to-noise ratio. References: 6 Russian.

EXPERIMENTAL STUDIES OF THE PROBABILITY DENSITY FUNCTION OF THE TIME
INTERVAL PRECEDING THE FIRST ZERO OF A RANDOM PROCESS

BEREZIN, L. V., KUPRIYANOV, A. I. and ROGACHEVA, N. V.

/Abstract/ The paper gives experimental results of a study of the probability density function of time intervals between instants when the reference voltage crosses the zero level and the first subsequent zero for a mixture of harmonic signal and noise. The results are found for various behaviors of the noise spectrum and signal-to-noise ratio. It is shown that the first approximation of the probability density function gives a satisfactory description of the statistics of time intervals preceding the first zero of a random process only in the case of a harmonic signal observed against a background of extremely narrow-band noise (where the ratio of the effective spectral width to the signal frequency is 2-3 percent or less). In the case of wide-band noise, where the upper frequency of the spectrum is much greater than the signal frequency, the probability density function of the time interval before the first zero is multimodal; estimates of the phase of the signal from measurements of the time interval will be biased. If the signal frequency lies close to the upper limit of the wide-band noise spectrum, there is an appreciable probability that there will be no zeros over the period of the signal, and consequently there may be anomalous errors in phase measurement from the readings of time intervals before the first zero of the process. Figures 5, references: 3 Russian.

OPTIMUM RECEPTION OF DISCRETE SIGNALS AGAINST A COMBINATION OF NOISE AND
PULSE INTERFERENCE

CHABDAROV, SH. M.

/Abstract/ The author considers problems of reception of fluctuating signals against a background of inter-apparatus and external noises and random radio pulse interference. Despite the non-gaussian nature of combined noise and pulse interference, it is shown that general methods of synthesis and analysis of polygaussian algorithms are applicable to such problems. By approximating the combined interference on the basis of a mixture of gaussian processes, the author is able to synthesize optimum procedures for

detection -- distinguishing useful signals from interfering pulses with fluctuating parameters. Circuits using conventional devices are proposed for detecting square pulses with Rayleign amplitudes and equiprobable phases when they occur at fixed and random times against a background of noises with random powers and several streams of chaotic pulse interference with Rice amplitudes. Interference immunity is analyzed and computational examples are given for a simple and technically convenient version of this detector. Figures 6, tables 1, references: 7 Russian.

AUTOCORRELATION RECEPTION OF COMPLEX PHASE-KEYED SIGNALS

CHERDYNTSEV, V. A.

/Abstract/ The author determines the principles of optimality (suboptimality) of an algorithm of an autocorrelation receiver assuming that the only known data for the received phase-keyed signal is its bivariate correlation function, and that the law of alternation of symbols of the modulating sequence is unknown. In this way a solution is found for the problem of synthesizing a receiver that is invariant to the shape of the phase-keyed signal. Because the autocorrelation receiver is invariant to the phase spectrum of the signal, it may be optimum for other signals with angle modulation as well. Figures 3, references: 5 Russian.

ADAPTIVE DIVERSITY RECEPTION UNDER CONDITIONS OF ACTION OF SPECTRALLY CONCENTRATED INTERFERENCE. PART I

FAL'KO, A. I.

/Abstract/ Algorithms are derived and analyzed for diversity reception while learning where there is concentrated interference in the channels, and the variation of interference parameters is Markovian. The adaptive algorithms are derived for learning by classified and unclassfied sampling of the interference. The algorithm for formation of estimates and threshold

levels is given for the case of coherent reception. The extreme cases of fixed interference parameters and relatively rapidly fluctuating parameters are considered. It is shown that in the case of fixed interference parameters the accuracy of determination of the concentrated interference increases with an increase in the learning sample, and in the limit the interference is completely compensated. Therefore these are called asymptotically optimum algorithms. On the other hand, in the case of rapid changes in interference parameters, the estimates are formed independently on each stage. In this case the interference estimates have to be formed with respect to the unclassified realization of the received mixture of signal and interference. It is shown that a matched filter can be synthesized in this case by series expansion of the functions of the mixture of signal and concentrated interference. Signal reception is determined mainly by the components that are not affected by interference. When the ratio of the interference energy at the receiver input to the spectral noise density is much greater than unity, band elimination of those signal components that coincide with the concentrated interference occurs. References: 11 Russian.

IVANOV, YU. V.

/Abstract/ The nuclear (spin) echo is used in signal processing devices and in controllable delay lines where conventional simultaneous and sequential analysis of signal spectra fail because of stringent resolution and bandwidth requirements. The performance of such devices is evaluated here by the three-pulse method: one radio pulse with a constant spectral function within the Larmor-frequency range preceding, and one radio pulse with a linear frequency modulation following the signal to be analyzed. The validity of this theoretical treatment has been confirmed experimentally, with the nickel ferrite $NiFe_2O_4$ containing the $Fe^{37}$ isotope which serves as the active medium and yields very close results within the Larmor band $\triangle f_o = 2$ MHz about the center frequency of 72 MHz. Figures 3; tables 1, references 8: 5 Russian, 3 Western.

OPTIMAL FILTRATION OF SIGNALS WITH DISCONTINUOUS AND DISCRETE STOCHASTIC
PARAMETERS

KAPYLOV, A. K. and CHERDYNTSEV, V. A.

/Abstract/ Stochastic differential equations are derived for determining
the optimal simultaneous estimates of both a discontinuous and a discrete
parameter of a signal in the case of a process characterizable by a stochas-
tic differential.  Such a process is constructed here in the more general
form of an expansion of semimartingales, without restrictions on the inter-
relation between signal and noise as well as that between discontinuous
and discrete parameters of a signal.  The results are compared with those
for the conventional less general case of a discrete Markov process.
References 18: 12 Russian, 5 Western, 1 German.

CONCERNING THE PROPERTIES OF M-SEQUENCES WITH MULTIPLE CLOCK FREQUENCIES

KORBUT, A. A. and TERESHCHATOV, A. F., Minsk Radio Engineering Institute

/Abstract/ An analysis is made of the properties of pseudorandom pulse
sequences of maximum duration (M-sequences).  It is shown that all M-
sequences regardless of the base (the number of possible levels of elementary
pulses in the sequence) when generated by polynomials of one class corre-
late with each other when their clock frequencies are properly chosen.  The
values of the clock frequencies of M-sequences of one class that are to be
correlated are selected by dividing polynomials by one another, or else as
elements of a number field with order equal to the period of the M-sequences.
The mutual correlation function of M-sequences of one class with multiple
clock frequencies that are being correlated has K main peaks over the entire
period of the low-frequency sequence, where K is the ratio of the clock
frequencies.  Neither the slopes of the edges of these peaks nor the levels
of the side residues differ from the autocorrelation functions of any of
the M-sequences that are correlated.  Figures 2, references: 4 Russian.

ADAPTIVE SEQUENTIAL ANALYSIS OF SIGNALS UNDER CONDITIONS OF A PRIORI INDETERMINACY

SHLOMA, A. M.

/Abstract/ Detection of signals is considered in the case of a normal ambient noise of unknown intensity. The algorithm is based on a modification of Stein's statistics and an application of Wald's rule, eliminating the effect of the unknown noise power on the detection characteristics. The procedure consists of comparing the likelihood-ratio statistics with two thresholds. This method is shown to be asymptotically optimal. References: 6 Russian.

ON THE CALCULATION OF THE OPERATIONAL CHARACTERISTICS OF A SEQUENTIAL DETECTOR FOR DISCRETE SIGNALS HAVING A BINOMIAL DISTRIBUTION

SKVORTSOV, V. S.

/Abstract/ Two decision making algorithms, which are known from the literature, are applied as a sequential criterion of the ratio of the probabilities for the checking of two simple hypotheses concerning the value of a binomial distribution parameter. Approximate calculation formulas for the operational characteristics of these two check algorithms are given in the form of explicit functions of the monitored parameter of a discrete random quantity having a binomial distribution. Functional schematics of the bidirectional binary counters which realize the two algorithmic rules are presented and expressions are derived for the average number of observations of the sequential detector in terms of the operational characteristics, where this number is equal to the probability of concluding that a signal is present at the input of the detector which has the true value of the parameter being monitored. This operational characteristic and the average number of observations are also shown graphically as a function of the true value of the parameter being monitored. Figures 3, references 6: 5 Russian, 1 Western.

ASYMPTOTICALLY OPTIMAL ALGORITHM FOR DISTINGUISHING POISSON SIGNALS

KUTOYANTS, YU. A.

[Abstract]  The author is concerned with the Poisson process as a good mathe-
matical model for describing the registration of emission electrons in a
photoelectron multiplier with a high level of amplification and in numerous
other areas.  This paper is devoted to the synthesis of an asymptotically
optimum algorithm for distinguishing two Poisson processes of variable in-
tensity.  As an example the author uses the problem of detecting a weak
Poisson signal observed on a background of Poisson noise with a large number
of observations.  He constructs the algorithms here in the case of independent,
discrete Markov and continuous Markov observations.  The author expresses his
appreciation to B. R. Levin for constant stimulation of the work.  References:
9 Russian.

LINEAR AND NONLINEAR MODELS OF CONTROLLED MULTIFUNCTIONAL SIGNAL PROCESSING
DEVICES

RYZHAK, I. S.

[Abstract]  Problems of signal processing by multifunctional parametric devices
are solved by a transformation from the model differential equation to an
equivalent model integral equation.  Integral equations treat the boundary
conditions more expediently, especially when the input signals and the control
action are complex pulses or frequency modulated, as the "stationary phase"
method becomes applicable then.  This transformation is performed here, using
separable circuits, for the rigorously linear model and for a nonlinear model
of such a device.  Saturation and asynchronism of the output signals are
expressed as functions of the total signal energy and of the control action.
The procedure is illustrated on the specific case of a rigorously linear
device with linearly-frequency-modulated input signal and control action.
Figures 3, references 12:  10 Russian, 2 Western.

USSR                                    UDC 621.391.2.223

ON THE PROBLEM OF OPTIMIZING RECEPTION OF DISCRETE SIGNALS IN THE PRESENCE
OF INTERSYMBOL DISTORTIONS AND GAUSSIAN NOISE

KOROBOV, YU. F. and FEDOROV, A. L.

/Abstract/ in the literature a number of methods of reception are described,
optimum in the presence of intersymbol interference and noise for various
conditions, connected primarily with complete consideration of a priori and
a posteriori information and consequently with complexity of reception.
The present paper determines the optimum algorithm of reception in the
simplest case when the signal being received is analyzed at a one-cadence
interval, and the noise immunity is investigated of quasi-optimum reception
of FM signals, which is compared with integrated reception and single read-
out. The error probability and energy losses are determined for the quasi-
optimum reception method. Figures 3, references 9: 7 Russian, 2 Western.

USSR                                    UDC 621.391.23

ON CALCULATING THE FAILURE PROBABILITY FOR A SYNCHRONOUS SYSTEM WITH A
BUFFER MEMORY AND RETRANSMISSION ON REQUEST

DOBATKINA, N. V. and ZHIGULIN, L. F.

/Abstract/ A synchronous transmission system with retransmission on request
and stand-by where it operates from an uncontrolled binary source with a
fixed information output rate is studied. The system configuration treated
is one in which its component part (subsystem) is a system with retransmis-
sion on request and stand-by for a controlled source. The information is
transmitted in the system for the controlled source in accordance with an
algorithm of Benice and Frey; to match the message output rates by the
source and their transmission via the subsystem, a buffer for storing mes-
sages is inserted between them. A procedure is developed for determining
the error probability of message transmission via this synchronous system.
The system operation is represented in the form of a finite automation and
shown in the form of a table; the probability model of the system is des-
cribed by matrices and the iteration formulas derived for finding the
vector of the final probabilities of states producing buffer overflow are
presented in tabular form. The proposed calculation procedure can be
extended to the case where the errors in the forward and return channels

are described by a Markov model. It can also be generalized for the case where a Schwartz algorithm or one equivalent to it is used in the subsystem. The system design is substantially complicated in this case, however, because of the increase in the number of its states. Figures 2, tables 2, references; 7 Russian.

ADAPTATION IN DISCRETE MESSAGE TRANSMISSION SYSTEMS

GINZBURG, V. V., GRISHOV, V. S. and OKUNEV, YU. B.

[Abstract] The authors consider the principles of adaptation in discrete message transmission systems, and define the place and role of the various methods of adaptation. In the sense discussed in this paper, adaptation means the process of changing the parameters and structure of a controlled object to optimize operation where there is initial uncertainty or variations in working conditions, the control being based on measurement of instantaneous values of external factors. In terms of communications systems, this means measurement of communication channel parameters and control of the working algorithms of the transmitter and receiver to optimize message transmission quality. Random processes that determine signal realization at the channel input are classified as wide-band (with spectral width of the order of that of the signal or wider) and narrow-band (with spectral width appreciably less than that of the signal). Channels in which the signal is distorted only by wide-band processes are called constant-parameter channels, while those with narrow-band distortions are called variable-parameter channels. The index to be optimized is taken as the coefficient of reliability of communication, defined as the percentage of time during which the instantaneous probability of error does not exceed a predetermined threshold level. Some theoretical results are considered that relate to synthesis of an adaptive communications system that is optimum with respect to this criterion. An example of an adaptive shortwave radio system is examined. Figures 3; references: 16 Russian.

USSR                                                    UDC 656.254.153.29

USE OF MODEL ARS-64 EQUIPMENT FOR ORGANIZATION OF COMMUNICATION FOR A POWER
LOAD DISPATCHER

STOTSKAYA, I. N., chief project engineer, "Giprotranssignalsvyaz'" [State
Planning and Surveying Institute for the Planning of Signalization,
Centralization, Communications and Radio in Railroad Transportation], and
DANOVICH, S. D., senior engineer

[Abstract] Power dispatching and automatic blocking along railroad routes
energized from 6 or 10 kV overhead lines requires a communication system.
Instead of erecting overhead communication lines parallel to the power lines,
the latter can be multiplexed with the use of model ARS-64 equipment built
domestically. The ARS-64 consists of a single telephone channel with a 15 km
range. It operates on carrier frequencies within the 18-66 kHz band subdivided
into five 12-kHz channels, can overcome an attenuation of up to 45.5 dB, and
is reliable at a low cost. Special processors and connectors are available
for hooking it to a 6-35 kV power line. An organization chart of such a
communication system is shown, with and without other existing telephone
channels. A cost versus distance graph indicates a cost of approximately
4000 rubles regardless of the distance to the district transformer substation,
within the 0-15 km range, as compared with a linearly increasing cost up to
approximately 28,000 rubles for 15 km of cable laying. For distances shorter
than 2.0 km, however, cable installation costs less than 4000 rubles and is,
therefore, a more economical alternative. Figures 2.


USSR


ODSP-30 COMMUNICATION CONTROL ROOM EQUIPMENT

/Abstract/ The ODSP-30 communication control room equipment for postal
enterprises, which was developed by the Central Design Office, Ministry of
Communications, USSR, is intended for organization of the operational com-
munication of a dispatcher with the services and other subdivisions sub-
ordinate to him. The equipment assures: loudspeaker (on the part of the
dispatcher) communication with local users; telephone communication with
local and distant users, as well as with users of automatic telephone
exchanges and control office switchboards; delivery of commands to the
connection of one information loudspeaker or groups of them; luminous
technological signaling. In addition, the possibility is provided for
recording telephone conversations on magnetic tape. The wide use of inte-
grated microcircuits, the use of electronic contacts for switching of

conversation circuits, and a minimum number of relays makes it possible to decrease the overall dimensions and the power requirements, as well as to increase the equipment reliability. Technical data are presented for the equipment. Figures 1.

PROBABILITY OF FALSE RECEPTION IN THE CASE OF INTERSYMBOL INTERFERENCE

VENEDIKTOV, V. T., MAKAROV, S. B. and TSIKIN, I. A.

/Abstract/ During transmission of discrete information through channels which contain selective band circuits, the presence of residual voltages from preceding elements of the signal, which cause intersymbol interference, can significantly affect the interference immunity of reception. A number of works in the literature are devoted to an analysis of the efficiency of reception under such conditions. However, in these works attention is either given to the problem of selecting optimum values of the pass band of the channel, or construction of linear filters which increase the ratio of the useful signal to the level of intersymbol interference. The present work considers optimum (from the point of view, for example, of the minimum magnitude of the average probability error) methods and the interference immunity of reception under conditions of limited time of analysis, with a fixed level of intersymbol interference. Figures 1, references: 5 Russian.

AN EXPERIMENTAL INVESTIGATION OF NONLINEAR FILTERING ALGORITHMS FOR TWO-TONE IMAGES

SVET, S. D.

/Abstract/ A newspaper text, containing 64 letters arranged in four horizontal lines of 16 letters each, was simulated on a BESM-4 computer for the purpose of studying nonlinear filtering algorithms for image enhancement. The algorithms for the optimum nonlinear filtering of the video signal were formulated on the assumption that the signal takes the form of a Markov

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chain with two states, while the interference is additive, normal white noise. The experiments found that for a signal/noise ratio of unit, vertically oriented nonlinear filtering decreases the error of probability by four times, while its horizontal counterpart effects a similar decrease of only two times under the same conditions. Spatial logic filtering and nonlinear spatial filtering were also studied, where a heuristic algorithm for spatial filtering was used to circumvent the lack of effective mathematical models of the two-tone image fields, and it was found that a combination spatial filter made it possible to read a text with a noise exceeding the signal power by five to seven times. In this case, with a signal/noise ratio of unity, the error probability after such filtering was decreased by a factor of 10 in 3 different texts. The results of comparing the different filtering procedures are represented graphically, and examples of filtered and unfiltered texts are shown. The author thanks D. N. Maksimov and Ye. A. Kochetov for much help in the development and conducting of the experiment, and discussion of the results. Figures 4; references: 4 Russian.

EVALUATION AND MEASUREMENT OF THE ENERGY SPECTRA OF INTERFERENCE IN A MAGNETIC RECORD-PLAYBACK CHANNEL

GITLITS, G. V., DEMINSKIY, V. A., SMIRNOV, YE. I. and FILINOV, V. N.

/Abstract/ The main source of error in non-contact recording on a magnetic disk is random fluctuations in the gap because of uneven spots on the disk, and resulting in spurious amplitude modulation of the playback signal. The percentage modulation depends on the record-playback speed, the type of recording medium, the wavelength of the recorded signal, and the method of producing the air cushion between the disk and the fixed plate. An examination of the energy spectra of spurious amplitude modulation of signals played back from a flexible disk showed noise maxima on frequencies that are multiples of the rate of rotation of the disk, as well as a strong component in the zero-frequency region. To determine the source of periodic fluctuations, experiments were done at different recording speeds and signal wavelengths with measurement of the energy spectrum of spurious amplitude modulation. It was found that the energy spectrum of the playback channel noise accompanying fluctuations in the gap between head and recording medium contains components of wave density harmonics and on the harmonics of the central frequency of the energy spectrum of the gap. This explains the maxima in the noise spectrum if the noises are measured by studying the spectrum of the envelope of the playback signal. These maxima increase with a reduction in recording wavelength. Figures 3; references: 4 Russian.

CORRELATIONAL PROCESSING OF RADIO SIGNALS IN REAL TIME

ZHUKOV, V. A., Leningrad Institute of Aviation Instruments

/Abstract/ Correlation processing of radio signals with dispersive analyzers of complex signals is considered where sample input signals $x(t)$ and $y(t)$, treated as random functions, are reproduced in the real time scale (producing time = sampling time). The apparatus consists of two such analyzers, one for $x(t)$ and one for $y(t)$, a mixer which multiples their Fourier transforms, and a third such analyzer which analyzes this product and yields an output signal whose envelope is proportional to the sought correlation function. The apparatus has been tested on various kinds of input signals such as phase- or frequency modulated ones, radio pulses, and noise pulses. This paper is recommended by the Department of Radioelectronics, Leningrad Institute of Aviation Instruments. Figures 2, references 8: 7 Russian, 1 Western.

A NONLINEAR FILTER ON THE BASIS OF NUCLEAR MAGNETIC RESONANCE

VLADIMIROV, V. M., KASHKIN, V. B., KROKHOV, S. I., SAVIN, A. K., and LUNDIN, A. G.

/Abstract/ The principle of noise-immune filtration of radio signals with the use of nuclear magnetic or electron parametric resonance is based on a properly nonuniform field and saturation absorption at resonance. A non-linear filter on the basis of nuclear magnetic resonance is shown here which constitutes two identical arms of a bridge, with the tank circuit in each arm containing the active substance. One arm is placed in a non-uniform magnetic field with the desired absorption characteristics. The other arm is placed outside this field. In effect, the device operates as a discriminator-limiter (or even suppressor). The substance must have an intensive and narrow NMR line and be chemically stable so that neither the spin-spin relaxation time nor the spin-lattice relaxation time will change much because of fluctuations of the ambient temperature. These two relaxation parameters must also have such values as to ensure the optimum noise suppression threshold. An experimental study of nuclear magnetic resonance on hydrogen nuclei (protons) in various silicon-organic fluids, namely

hexamethyl disilicoxane oils $[(CH_3)_2SiO]_x$, and measurements of the basic performance characteristics indicate the effectiveness of such filters. Figures 7, tables 1, references 5: 1 Russian, 4 Western.

MODEL-APT APPARATUS FOR TELECOMMUNICATION CHANNELS IN POWER SYSTEMS

BARANOVA, V. B., POBEREZHSKAYA, R. D. and SOKOLOV, V. B., engineers, VNIIE [All-Union Scientific Research Institute of Electric Power Engineering]

[Abstract] An apparatus for transmitting and receiving telemechanical information over power systems has been developed. Three models are rated for 100 bodes, one for 200 bodes, and one for 300 bodes. They are designed for multiplexing the 2500-3400 Hz channel (upper telephone band) in any HF communication system, and can be installed on overhead lines as well as on underground cables. They operate in one normal mode with bipolar or unipolar messages, as well as in four different channel tuning and checking modes. A schematic block diagram is shown, the essential design and performance data are given. Series production of APT apparatus of improved construction began in 1975. The apparatus has already been in use in several power systems and performs satisfactorily. Figures 2; tables 2.

A METHOD FOR CALCULATING THE DISTORTION OF PULSE SIGNALS WHEN PASSING THROUGH A BANDPASS SYSTEM WITH AN ARBITRARY AMPLITUDE-FREQUENCY AND PHASE-FREQUENCY RESPONSE

VOL'MAN, A. A.

[Abstract] A method is presented for calculating the distortions of pulse signals which permits a simpler solution of the problem of finding the shape of the signal at the output of a system with an arbitrary amplitude-frequency and phase-frequency response. The signal at the output of a real system, $F(t)$, is represented as the sum of the signal at the output of an ideal bandpass filter $F_1(t)$ and the signal distortions, $\Delta F(t)$, which are caused by the deviations of the amplitude-frequency and phase-frequency response

of the actual system from that of the ideal. Introduced into the expression for the signal distortion, $\Delta F(t)$, is the product $\overline{/K}(\omega) - 1/S(\omega)$, where $K(\omega)$ is the complex transfer factor of the system, and $S(\omega)$ is the enveloping spectrum. For pulse signals in actual systems, this product is an oscillating function which can be expanded in a Fourier series with a comparatively small number of terms (one-two), something which permits deriving a rather simple formula for the signal distortion, $\Delta F(t)$. The relevant expressions are derived, and these substantially simplify the finding of the response of a system with an arbitrary amplitude-frequency and phase-frequency response to pulse signals. The author expresses sincere thanks to Professor A. A. Pirogov for valuable council and remarks made by him concerning the paper. Figures 7, references: 3 Russian.

OPTIMIZING THE CONTRAST SENSITIVITY OF ELECTRICAL IMAGE TRANSMISSION SYSTEMS

YEFIMOV, A. S.

/Abstract/ Contrast sensitivity for an electrical image transmission system should be defined in terms of the overall number of distinguishable half-tone gradations, as well as the change in the dynamic range of the image being transmitted. The criterion of optimality for the contrast sensitivity of applied image transmission systems is the meeting of two conditions: maximizing the total number of distinguishable gradations and providing for the requisite character of the change in the contrast sensitivity of the system with respect to the dynamic range of the transmitted image. Nonlinear sections are used in the transmit and receiver amplifying channels, and it is possible to optimize the contrast sensitivity through the selection of the amplitude characteristics of these channels. These characteristics can be found by solving regular or conditional problems in the calculus of variations. Figures 1, references: 3 Russian.

USSR                                              UDC 621.394.147

CODES THAT ARE INSENSITIVE TO 'INVERSE WORK'

KAMINSKIY, V. I.

/Abstract/ The author considers the feasibility of decorrelating errors to improve the interference immunity of relative phase modulation without impairing its advantages for discrete communication. It is shown that error doubling (grouping) can be eliminated in communication channels with relative phase modulation by using error-correcting codes without resorting to code redundancy. It is also shown that the information rate can be increased by interchanging the decoder and the relative-to-absolute code converter. Figures 1, references: 3 Russian.

USSR                                              UDC 621.395.34

EFFECT OF SPECIFIC CHARACTERISTICS OF A CONVERSATION ON ITS LENGTH

KAGRAMANOV, A. G.

/Abstract/ The mean time of channel occupancy is one of the parameters affecting the design and the capacity of automatic telephone exchanges. This parameter as well as the subscriber load depend largely on the length of conversations. The latter is examined here in relation to the subscriber structure. Statistical data are shown for three cities (Baku, Tbilisi, and Yerevan) and analyzed in terms of social patterns and customs. In technical terms, it is noted that long conversations tend to increase the number of busy signals and thus contribute to an inefficient loading of the network. Figures 2, tables 3, references 7: 5 Russian, 2 Western.

USSR                                                    UDC 621.395.127

IMPROVEMENTS IN THE METHODS OF OPERATING URBAN TELEPHONE NETWORKS

MALINNIKOV, V. V., NOVOZHILOVA, E. V., and SOROKIN, V. A.

/Abstract/ In accordance with the August 1976 decision of the Central Committee of the Communist Party USSR, measures are being taken to improve the maintenance in all communication systems generally and in urban telephone systems particularly. The major two delineated trends are installation of automatic telephone exchanges with an attendant transition, where possible, from control-testing to control-corrective techniques, and better management of the technical services center in terms of operation, quality control, and analysis. Progress already underway in the Leningrad Metropolitan Telephone System is discussed, and some projections of what will be accomplished are made. Figures 2, tables 1, references 7: 5 Russian, 2 Western.

USSR                                            UDC 621.395.34.019.3.001.24

EFFECT OF PERIODICAL CONTROL ON LOSSES IN ELECTRONIC AUTOMATIC TELEPHONE EXCHANGES

BUROV, P. N., GOLOMSHTOK, L. V., ZARETSKIY, K. A. and SUTORIKHIN, N. B.

[Abstract]  A method is presented for calculating the losses in the switching system of an electronic automatic telephone exchange, with the unreliability of the equipment of group pulse circuits and channels taken into account, and an investigation is made of the effect of a control period $\tau$ on the magnitude of the losses, using as an example a single-unit fully-accessible system. It is found that in the case of actual loads of the system, the control period affects the losses to a considerable degree. After assignment of the permissible value of losses of calls, with unreliability of the equipment taken into account, it is possible to select an optimum control period. With large loads, the control period affects the size of the losses to a lesser degree, particularly with small values of the parameter of the flow of calls of the equipment. The calculation of losses described can also be extended to a more complex case, with the presence of several ranks of group equipment, as well as to multiunit circuits of electronic automatic telephone exchanges. Figures 3, references: 5 Russian.

USSR

OPERATION OF A 100/2000 CROSSBAR-TYPE AUTOMATIC TELEPHONE EXCHANGE

Moscow AVTOMATIKA-TELEMEKHANIKA-SVYAZ' in Russian No 3, Mar 77 pp 31-32

ZIMINA, N. M., senior electrician, Chitinsk range of the Trans-Baykal Railroad

[Abstract] An increasing number of crossbar automatic telephone exchanges has been recently installed throughout the railroad network. Four such exchanges were installed at the Chitinsk range during the past Five-Year Plan, with a total capacity of 3400 numbers. A crew of five specialists completed all cable and bay work, connections, checking, and testing. On the basis of experience in installing and subsequently operating this equipment, several recommendations are made pertaining to standard procedures. It is suggested, for example, that certain key components be checked out routinely and, if necessary, replaced more frequently than once a year. Some problems such as the burning of relay contacts have not yet been solved and are referred to the manufacturer. Figures 1.

USSR                                                                    UDC 621.395.345

STRUCTURE OF CONTROL SYSTEMS WITH A RECORDED PROGRAM FOR AUTOMATIC TELEPHONE EXCHANGES

Moscow ELEKTROSVYAZ' in Russian No 2, 1977 pp 36-40 manuscript received 18 18 Sep 75

MISULOVIN, L. YA.

/Abstract/ The use of control systems with a recorded program has introduced a number of new problems, connected in particular with construction of switching systems. Important problems of assuring economy of stations with a wide range of capacities and assuring their specified reliability are discussed in the present paper. It is found that the major portion of the cost of control systems (CS) based on a minimum limit is created by programmed storage, and on a maximum by the working storage. The major problem during planning of CS is minimization of the volume of the programs and use of memories of minimum cost. For the characteristics of the CS, together with other parameters, it is necessary to use its initial cost. If a switching system of large capacity is predominate on a communication network, then it is advisable to use a series of CS with different initial costs and productivity; if a small capacity, then a multiprogram structure. For a CS based on elements on the third generation, a combination is necessary of parallel operation of two CS with a comparison of the results and built-in control of each of the CS. For CS based on elements of the fourth generation, with practically 100 percent built-in control, independent operation is possible of two CS with periodic equalization of data into the working storage. Figures 4, tables 1, references: 14 Russian, 6 Western.

USSR

NUMBER CONVERSION AND CONNECTION DEVICE

Moscow ELEKTROSVYAZ' in Russian No 4, Apr 77 p 66

/Abstract/ Described is a new number conversion and connection device
which is intended, in conjunction with a supplemental group selector, to
improve the operation of ten-step automatic telephone exchanges with
special services, which have two and three digit numbers, with the first
digit being "zero". The unit is designed for servicing 40 junction lines
and its operation and structure are briefly described. A photograph of the
unit is provided and technical data are given. The device was developed by
the Central Design Office of the Ministry of Communications, USSR.
Figures 1.

USSR

AN AUTOMATED SYSTEM FOR MONITORING AND VERIFYING THE PARAMETERS OF MULTIPLEXED
JUNCTION CIRCUITS IN MUNICIPAL TELEPHONE EXCHANGES

Moscow VESTNIK SVYAZI in Russian No 2, Feb 77 pp 22-25

MICHURIN, chief of the cable-radio relay department of Mius Central Office,
Moscow Municipal Telephone Exchange, KORNEYEV, A. S., candidate of technical
sciences, senior engineer, Moscow Municipal Telephone Exchange, and
SIROTINSKIY, V. V., senior engineer, line equipment center

[Abstract] The article describes the ASKP-U system developed by the Moscow
Municipal Telephone Exchange for automated monitoring and verification of
junction circuits formed by the channels of equipment of the KRR-M and KAMA
type and of equipment with pulse-code modulation. The parameters that can
be checked include set noise, net loss (gain), signal routing and proper con-
nection to the transponder with simultaneous monitoring of the working order
of the pilot wire, as well as the time parameters of the pulse corrector (for
incoming connector relays). The electrical characteristics of the channels
are measured in a two-wire circuit on the outgoing side of the channel by a
technique patented by A. S. Korneyev (USSR Author's Certificate No 302837).
The incoming channels are verified in opposite line equipment centers by
analogous monitoring systems. Transponder connections are verified on both
incoming and outgoing channel terminals. The ASKP-U system operates in
automatic, semiautomatic and manual modes. Block diagrams of the commutation,
measurement and control circuits are given and the operation is explained.
An experimental model of the system has been built that covers more than
5000 channels. Figures 2.

USSR

IMPROVEMENT OF TELEGRAPH COMMUNICATION ON THE BASIS OF NEW TECHNICS
(RESULTS OF SEMINAR)

TUMANOVSKIY, YE. I.

/Abstract/ A seminar devoted to improvement of telegraph communication on
the basis of new technics took place in September 1976 at the capital of
the Ukraine. The seminar was organized by the Republic House of Economic
and Scientific-Technical Propaganda of the "Znaniye" Society of the
Ukrainian SSR, together with the Kiyev Branch of the Central Scientific-
Research Institute of Communications, and the Ukrainian Republic and the
Kiyev Oblast governing boards of the Scientific and Technical Society of
Radio Engineering, Electronics and Communications imeni A. S. Popov. More
than 120 persons took part in the work of the seminar -- representatives of
scientific, planning and educational institutes of the Ministry of Communi-
cations, USSR, and the Union Republics, Oblast communication administrations,
design organizations of industry, and communication enterprises. A number
of items dealt with at the seminar are discussed, and the names of those
concerned with a particular type of subject are presented.

USSR                                                           UDC 621.394

THE VPE ELECTRONIC TELEGRAPH CALL-UP DEVICE

GROMOV, YE. M., ZARYANOVA, N. M., KOROP, B. V., and YAROSLAVSKIY, L. I.

/Abstract/ A new fully transistorized telegraph call set is described,
where this set permits an operator to connect communications channels
through to the terminal being called. The new VPE unit is compared with
previous models, and the following advantages are cited: Bipolar telegraph
signal transmission, line voltages of $\pm 20$ volts as compared to $\pm 120$ for
previous models, a telegraph transmission rate of 200 bauds as opposed to
50, and the replacement of relays by transistors, plus other operational
advantages. The design MTBF is 10,000 hours. The operation of the device
on a switched telegraph network is described, the circuit design is dis-
cussed and illustrated by a block diagram and a schematic, and a photograph
of the unit is provided. The VPE permits stabilizing all the time parame-
ters of the call-up unit, reducing telegraph distortions introduced by the
set, providing for touch tone dialing of a number and telegraph signal

relaying, substantially increasing call-up set reliability, eliminating alignment during operation and significantly improving ergonomic indicators of the set. Experimental models of the VPE have undergone operational testing and their series production has been set up at the Minsk "Promsvyaz'" plant. Figures 4, tables 1.

USSR                                                                    UDC 621.396.626

ON EVALUATING THE NOISE IMMUNITY OF FREQUENCY RADIO TELEGRAPHY IN THE PRESENCE OF HIGH-POWER PULSE INTERFERENCE

KUZ'MIN, B. I.

/Abstract/ The influence of high power pulse interference on the noise immunity of a discrete radio channel is treated. It is assumed that the level of the fluctuating noise is neglectably small in comparison with the useful signal and that the probability of steady state interference is significantly less than the probability of the high power pulse interference. Formulas are derived for the calculation of the wrong decision, erase and complete loss of accuracy probabilities for a frequency telegraphy radio channel with erasure of the uncertain symbols. These formulas apply to radio receivers with step and loop characteristics for the response of the polarity analyzer in the presence of high power pulse interference. Figures 2, references: 11 Russian.

USSR                                                                    UDC 631.396.4

A METHOD OF EFFECTIVELY UTILIZING AUDIO FREQUENCY CHANNELS FOR DISCRETE SIGNAL TRANSMISSION

DIVNOGORTSEV, G. P.

/Abstract/ The article is intended as a preliminary discussion of the reasons for and a method of making a transition from frequency division of AF channels to timewise distribution of the signals in discrete information transmission systems. The possibility of creating a standardized, highly efficient network of discrete channels, equipped with Modem-4800's (or Modem-9600's), is discussed. The division of the signals, for any type of discrete information, is realized among the correspondents by

timewise distributors.  A circuit for the transmission of the signals is described for this method, and a comparison is made with existing transmission systems.  It is noted that all the prerequisites for such a system are now in existence, with the exception that only the timewise signal distributors have to be developed.  Figures 1, references 6: 5 Russian, 1 Western.

SHCHELKUNOV, K. N., BRAUDE, V. B. and MODEL', M. D.

/Abstract/  A comparative analysis is done on the rate of data transmission in quantum communication channels for different types of carrier modulation. The study is based on a general approach in which transmission rate is determined as a function of the average number of photons per signal element.  Discrete channels are considered with binary pulse-amplitude modulation (BPAM) and multiposition pulse-phase modulation (MPPM).  These forms of modulation are compared for different preassigned conditions by a quantitative evaluation of the maximum attainable data transmission rates. A narrow-band channel is assumed in which there are no other noises besides the quantum noises of the signal.  The problem of optimizing MPPM is considered, and it is shown that this kind of modulation can be competitive with BPAM only when the specific traffic capacity of the quantum channel becomes appreciably less than 1 bit per Hz of the band, i.e. in the weak signal region.  To achieve any appreciable gain from the use of MPPM, the band must be repeatedly expanded with a corresponding increase in the number of passive signal elements, which considerably complicates the technical realization of the communication system (problems of speed, synchronization, recoding and so on).  Figures 4, references 9: 7 Russian, 2 Western.

USSR

# CHOICE OF THE OPTIMUM RADIOVISION SYSTEM

GEL'FER, E. I. and MENSOV, S. N.

/Abstract/ For detection and observation of remote objects, the use of millimeter waves has recently begun. The two basic methods are direct quasi-optical radiovision and radioholography. The principles of both methods are compared, with particular emphasis on the effect which the quality of the objective lens has on the image distortion. The latter problem is analyzed as a one-dimensional one in a Fresnel-diffraction approximation. Calculations for a standard parabolic reflector antenna with a diameter of 130 cm and a focal length of 50 cm indicate that, while in direct radiovision the distortion increases with increasing distance from the object, in radioholography the image quality is hardly affected by aberrations of the objective lens. Figures 3, references 8: 5 Russian, 3 Western.

USSR

# INTERFERENCE IMMUNITY OF DIGITAL TRANSMISSION BY A RELATIVE PHASE MODULATION TECHNIQUE IN THE CASE OF DEEP SIGNAL FADING

VETYUGOV, A. I.

/Abstract/ A theoretical analysis is done on the interference immunity of digital transmission by the relative phase modulation method over radio lines for isolated reception of primary digital signals. The analysis shows the potential possibilities and effectiveness of the relative phase modulation method in the case of deep signal fading. It is shown that slow deep fading leads to a large number of different error groupings. The multiplicity of errors depends on the error correlation coefficient in the radio line. With increasing length of the error groupings, their multiplicity steadily decreases. The steepness of this decrease depends considerably on the depth of signal fading. The proposed method can be used to calculate the interference immunity of digital transmission over radio lines for coherent reception methods and various modifications of relative phase modulation. The author thanks A. S. Sukhorukov for constructive criticism. Figures 2, tables 1, references 12: 8 Russian, 4 Western.

USSR

A METHOD OF CALCULATING THE DETECTOR CHARACTERISTICS FOR A PACKET OF
INDEPENDENTLY FLUCTUATING PULSES

NARTOV, YE. V.

/Abstract/ A simple method of calculating the detection characteristics
for a packet of fluctuating pulses where each sample value is distributed
according to a Rayleigh law is given, where the method does not require
referring to tables of special functions. An expression is given which
permits calculating the probability of exceeding a threshold from Poisson
distribution tables or a recurrence formula. References 4: 3 Russian,
1 Western.

CONTINUOUS CHECKING OF THE PARAMETERS OF INTERURBAN BROADCASTING CHANNELS

SUL'G, M. P. and IOFFE, M. G.

/Abstract/ Automatic checking of the quality indicators of the audio
channel makes it easier to ensure a better performance of radio broadcast-
ing equipment. Most problematic are interurban audio communication
channels, which usually operate in the high-frequency band and where the
net attenuation as well as the noise level will most likely fluctuate
beyond the allowable limits. A series manufactured model KDK transmitter
and receiver set is now available for automatically checking these two
parameters continuously at an adequately high frequency. The probabilities
of the two basic random errors, namely of false fault indication and no
fault indication, are very low, except the probability of a not indicated
excessive noise level ($P \approx 0.07$), This is permissible, however, inasmuch
as excessive noise not detected during one pause is likely to be detected
during the next pause. On the other hand, an attempt to lower the proba-
bility of a not indicated excessive noise level would bring about a higher
probability of a false fault indication and this is not permissible. The
apparatus operates with a pilot signal at $320\pm0.5$ Hz and $63\pm0.5$ dB across
a $300\text{-}\Omega$ load. It operates from a $24\pm2.4$ V dc source and draws 24 W.
Figures 2, references: 8 Russian.

USSR UDC 656.25.0171.84

# ENGINEERING DIAGNOSIS OF AUTOMATION AND TELEMECHANICS APPARATUS

DMITRENKO, I. YE., head, Department of Automation, Telemechanics, and Communication, All-Union Correspondence Institute of Railroad Transportation Engineers, candidate of technical sciences; SAKHNIN, A. A., dotsent, candidate of technical sciences; and DURNEV, A. I., chief, Engineering Department, Main Administration of Signalization and Communication, Ministry of Railroads

/Abstract/ This is the first part in a series on engineering diagnosis of automation equipment. It deals with the basic methods of finding and removing faults. Diagnostic tests are described here, truth tables based on AND or NOR logic are shown, and the principles of constructing optimal checking algorithms are outlined. These algorithms are based on information theory, probability calculus, and sequential analysis. Extensive special-purpose programs have been developed for such systems as, for example, a railroad network. Figures 5; tables 11.

USSR UDC 656.25:621.317.7

# A DIGITAL DEVICE FOR MEASURING THE TIME PARAMETERS OF A CODE AND A RELAY

SOKOLOV, V. I., dotsent, Ural Electromechanical Institute of Railroad Engineers, VALIYEV, SH. K., assistant, and TREPSHIN, V. F., graduate student

/Abstract/ A digital device has been developed which measures the width of pulses and pauses in a code cycle generated by a transmitter relay. It also measures the relay actuation time (from the instant a voltage is applied across the relay coil to the instant the back contactors open or the front contactors close), the armature dropout time (from the instant the voltage is removed to the instant the front contacts open or the back contactors close), and the time between closing or opening of one contactor pair and opening or closing of the other contactor pair. The instrument scale is divided into ranges 1-9990 ms and 10-9990 ms, with the discrete error of $\pm 1$ ms and $\pm 11$ ms respectively. The operation of this device is based on the principle of time-to-pulse conversion, i.e., on recording the number of time calibration markers which enter the counter circuit during a given measured time interval. The device consists of an interval forming component and the actual interval measuring component, the major elements of both being shown and analyzed here (including the instrument panel). The instrument was successfully tested. It is 300x300x170 mm in overall size,

it eliminates subjective reading errors, and it can be easily controlled.
A set of units is now being built at the Experimental Plant of the Central
Scientific-Research Institute of the Ministry of Railroads, USSR, for
remote signaling and communication of the Sverdlovsk department. Figures 5.

CZECHOSLOVAKIA

ANALOG MULTIPLEXERS MADE OF DOMESTICALLY PRODUCED COMPONENTS DESIGNED FOR
CONTROL BY TTL CIRCUITS

BERNKOPF, JAROSLAV, engineer

[Abstract]  Czechoslovakia does not produce analog semiconductor relays which
could be controlled by TTL circuits.  Only TESLA offers an integrated sixfold
relay MH 2009, and MH 2009A.  Such relays require high operating voltages, of
at least 15 V.  The six channel analog multiplexer MH 2009 can be adjusted
for operation with TTL circuits by combining it with a decoder MH 74141 and
counter MH 7490.  A still better arrangement is obtained by using transformer
MZH 185 with a circuit MH 7403.  Operation of the assembly requires only a
voltage of 5.5 V.  This circuit can be used both as a multiplexer, and as a
demultiplexer.  This unit is described as a 2 x 2 channel analog multiplexer.
Figures 3.

CZECHOSLOVAKIA

OPTICAL WAVEGUIDES IN COMMUNICATIONS ENGINEERING

KOVAR, JAROSLAV, dr

/Abstract/ Transmission of signals by means of light rays has not been
studied as yet in Czechoslovakia.  Therefore the author describes this tech-
nology to Czechoslovak readers on the basis of developments achieved in the
United States, West Germany, and Japan.  Principles of total reflection
for capturing a monochromatic light ray in a small diameter circular channel
are discussed.  Such channels should be made of extremely pure silica pre-
pared by distillation of $SiCl_4$ and contain less than 0.01 ppm of impurities.
Only $B_2O_3$ may be present in higher amounts.  The best light source is a
He - Ne laser.  In laboratory work, losses in intensity of light of two
dB/km were achieved in the USA and below one in Japan.  Industrial values
are on the order of 30 to 100 dB/km.  For short distance transmissions of
up to 300 meters, multimode waveguides with step changes in the refractory
index are used.  For medium distances of up to three kilometers gradient
index waveguides are suitable.  The light channel is about 50 micrometers
diameter with a 20 micrometer clearance of the annular space between the
outside channel wall and the inside wall of the envelope made of the same
quality highly pure silica.  Such an arrangement results in a "self-
focusing" travel of the light ray through the guide.  In connection with

transmission diodes frequencies of about 200 M bytes/sec are obtained. The main advantages of optical ray signal transmissions is their immunity from interference and the absence of electromagnetic waves in the transmission of signals. Such transmissions are mainly suitable for computer applications, in aviation, and in telecommunication centers. The problems for their use for distances exceeding two miles have not yet been solved. Figures 5, references 13: 5 Czech, 2 Russian, 6 Western.

EAST GERMANY

CONVERTING RACK VSU 1800 FOR SECONDARY GROUPS AND BASE 15 SECONDARY GROUP UNITS

CHOMSE, DIANA, Chamber of Technology, Leipzig

[Abstract] The VSU 1800 equipment is a device for converting base-secondary groups into base-15 secondary group units and further into the conduction band 312 up to 8120 kHz. It belongs to the terminals in V-construction for carrier-frequency transmission of 1800 channel bundles by the four-wire congruent-band system, according to the demands of the Internal Consultive Commission for Telephone and Telegraph. It is a variant of the formerly (Ibid.: pp 51-56) discussed device VSU 300/960. The carrier frequency and pilot supply, the central supervisory- and control device and the generating plant belong to the fundamental equipment of the VSU 1800. The principal technical data of the electrical and construction system, including the converting device, the carrier frequency and pilot supplies, the supervisory and control devices, the power pack and signalling apparatus are discussed with reference to block diagrams as well as the allocation plan showing the housing of the VSU 1800 converting devices in a rack with 16 level soles. This report is from the combine of the state enterprise, Fernmeldewerk [Telecommunications Plant], Leipzig. Figures 6.

EAST GERMANY

PRIMARY AND SECONDARY GROUPS MODULATOR RACK VSP 300/960

East Berlin FERNMELDETECHNIK in German No 2, 1977 pp 51-56

ROEPPENACK, J., Chamber of Technology, Leipzig

[Abstract]  The VPS 300/960 is a combined primary and secondary groups modulator
rack of V-type designed for carrier-frequent transmission of 300, or else 960
channel groups by the four-wire congruent-band system.  The line spectrum in
the 1.3-MHz-TF [carrier frequency] system (60-1300 kHz) as V 300 and in the
4-MHz-TF system (60-4028 kHz) as V 960 can take place over coaxial cables as
well as over radio relay systems.  The rack can incorporate the converting
apparatus for the formation of the network spectrum of three 300-channel
groups or of one 960-channel group.  Two carrier supplies, the pilot supply,
a central monitoring system and regulating device and a power generating plant
belong to the basic equipment.  The electrical system and the design are dis-
cussed by reference to block diagrams and the application possibilities and
equipment variants are reviewed.  A detailed list of technical data includes
the fundamental parameters and the terminal properties.  This report is from
the combine of the state enterprise Fernmeldewerk [Telecommunications Plant],
Leipzig.  Figures 8, references:  2 German.

EAST GERMANY

COMPLEX SOLUTIONS IN COMMUNICATION TECHNICS AT THE FOREFRONT OF THE OFFERINGS
OF BROADCASTING-COMMUNICATION TECHNICS AT 1977 LEIPZIG SPRING FAIR

East Berlin FERNMELDETECHNIK in German No 2, 1977 pp 45-48

MITTANK, H.

[Abstract]  The demonstration of complex solutions in communication engineering
is well to the fore in the offerings of the 1977 Leipzig Spring Fair, including
selected problem solutions the underlaying technical principles of which are
reliable new products of broadcasting-communication technics.  Demonstration
examples are suggested for the complex solution of technical communication
problems in the telephone exchange field.  The new intercommunication plant
II-1/5 is provided for smaller enterprises.  The applications of the demon-
strated carrier terminal systems VZ 12 and STF 12+12, of the converting stand
VSU 1800, the voice-frequency telegraphy portable set VWT 6, the intelligence
receiver EKD, the transceiver SEG 15D and of the commercial communications
transmitter KN 1-E are described.  The subjects of five papers to be presented
at this year's Leipzig Spring Fair are indicated. Figures 12.

EAST GERMANY

DECENTRALIZED COMPUTER CONTROL IN TELEPHONE EXCHANGE SYSTEMS

POREP, H.-G., Chamber of Technology, Dresden

[Abstract]  The problem is analyzed as to whether and to what extent more favorable parameters of modern telephone exchange systems can be obtained by decentralization of the control and without abandoning the hitherto attained advantages.  Decentralization possibilities, such as peripheral information concentration, division of the exchange processes in subprocesses, and control decentralization are analyzed.  For a 10,000-central office for modern telephone exchanges, the cost part of the centralized control ᷍ 20 percent.  Preliminary investigations for a decentralized computer control in telephone exchange systems indicate that there are starting points based on new structural elements which comply with the technical and economical requirements.  This report is from the Data Processing System of the Technical University, Dresden.  Figures 5, references 5:  2 German; 3 Western.

EAST GERMANY

NEW TELEPHONE TECHNICS IN OFFICES--THE LOUD-SPEAKING TELEPHONE SET LF700

KRAUTWER, R.

[Abstract]  The LF66 loud-speaking telephone has been developed and taken into production as type LF 70 at the state enterprise Stern-Radio Rochlitz of the Armstadt combine.  The LF70 is a combination of a standard telephone set with an electronic telephone arrangement of the incoming and the outgoing signals. It is distinguished by a high call quality, reliability of the electronic equipment and a high degree of safety against acoustic feedback.  It uses supply voltages of 24-60 V.  The serviceability and technical data on the LF700 set are presented.  Figures 2.

EAST GERMANY

TELEMETRY SYSTEM FOR THE METEOROLOGICAL ROCKET M100

ANDERSON, A., GOERSCH, R. and ZIMMERMANN, G.

[Abstract]  The telemetry system for the meteorological rocket M100 consists of two complexes, the airborne telemetry in the rocket and the airborne receiver station for the recording of signals.  During the flight the telemetry system transmits signals to the ground with the help of a sender with 6 sub-carriers of the IRIG norm by the frequency-multiplex system MSP-1 or by a 16-channel commutator using the time-multiplex system MSP-2, the transmitting frequency being 136 MHz and the reflected power 0.5 W.  The working principles of both systems are explained by reference to block diagrams.  The advantages and the disadvantages of both transmitting methods are discussed and the working principle of the M100 ground receiving station is described by reference to its block diagram.  Because of the selected receiver type, a following antenna can be abandoned.  The telemetry system described can also be installed on ships with a M100 starting device.  This report is from the Electronics Institute, Academy of Sciences, GDR.  Figures 8, tables 3.

HUNGARY

GROUP OF COAXIAL PRODUCTS

HARGITAI, GEZA, graduate electrical engineer, group leader, Main Transmission Engineering Development Department, TRT /Telephone Factory/

/Abstract/  This article reviews briefly the group of coaxial devices made by TRT, specifically the multi-channel transmission units operating through coaxial cable and telephone relay in 300-, 960-, and 2700-channel systems. Most devices are built on the basis of a foreign license.  The type BK-960 and BK-2700 devices use small and large coaxial cables which conform to CCITT recommendations; the Type BK-300 devices use small coaxial cables. The line section is built up from so-called hypergroups each containing 15 secondary groups.  Modem /modulator demodulator/ stages, multiplex units, channel modem devices, primary and secondary group pilot control units, central control and pilot signal generators, line amplifiers, pilot control systems, line branch devices, remote supply units, service connections, and line compensators are briefly described, and fault localization procedures discussed.  A new frame insert method of construction, the so-called E2 method, is employed in the group of products.  Figures 8.

DIELECTRIC BARRIER ON THE IMPEDANCE JUMP IN A SURFACE WAVE LINE

NEFEDOV, YE. I., Institute of Radio Engineering and Electronics, Academy of
Sciences USSR, Moscow

[Abstract]  Open waveguide structures of the surface wave line type are ex-
tensively used in microwave and optical equipment.  A typical nonhomogeneity
in such waveguides is a dielectric "step" on the impedance plane.  Usually
the height of this step is such that the field of the surface wave does not
see the upper edge, and in a model problem the height of this barrier can be
taken as infinitely high.  In addition, the author considers the case where
the dielectric barrier is at the transition point between the two impedances
$Z$ and $\hat{Z}$.  The key problem for calculating structures of this kind is shown in
the diagram.
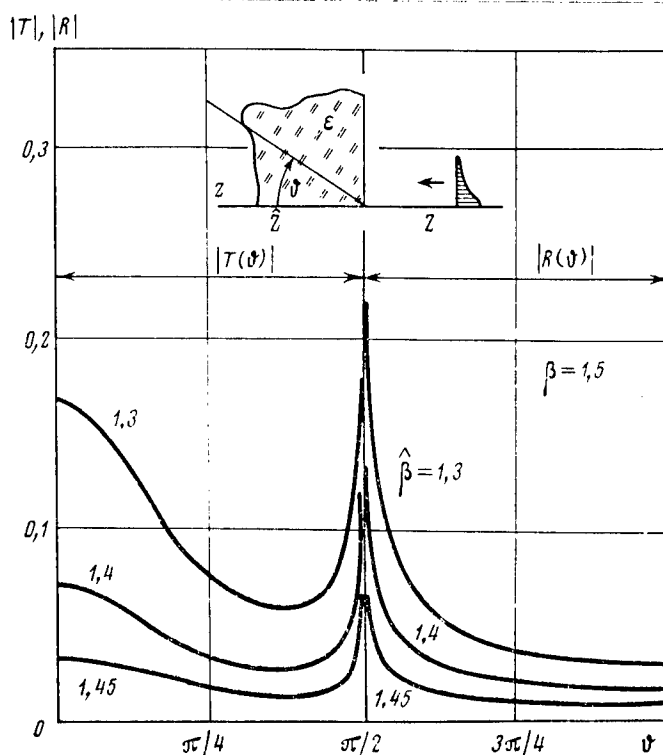
Figure 1

For the sake of simplicity, the two-dimensional problem ($\partial/\partial x \equiv 0$) is considered,
where the half-plane with different impedances $Z$ (when $z < 0$) and $\hat{Z}$ (when $z > 0$)

lies in a single plane xz. The quadrant of the half-space where y and z are positive is filled with a uniform dielectric with permittivity $\varepsilon$. Conditions are found under which reflection of the incident wave from the wall z=0 may be compensated by reflection-reducing coatings. This effect of compensation of the emission field because of the impedance jump $Z - \hat{Z}$ could be put in use by proper selection of the barrier permittivity for overcoming the break in the surface wave line at the suspension point, rotating the line through a given angle, excitation of a resonant dielectric (ferrite)prism, etc. The problem is solved for a small impedance jump, and it is shown that a dielectric prism can be effectively excited by selecting the angle $\theta$ (measured counterclockwise from the positive direction of the z-axis) so that the maximum of the radiation pattern coincides with the angle of total internal reflection of the prism. The author thanks B. Z. Katsenelenbaum, P. Ya. Ufimtsev and V. V. Shevchenko for interest in the work and for taking part in discussing it. Figures 2, references 8: 7 Russian, 1 Western.

CONTROLLED DEVICES ON C-SECTIONS WITH AN ADDITIONAL CONDUCTOR

VOROB'EV, P. A., VERSHININ, I. M. and MALYUTIN, N. D.

/Abstract/ A strip line consisting of a C-section and a control strip constitutes a three-conductor system which can be described by a matrix which combines its C-matrix and L-matrix, the latter being convertible to an equivalent C-matrix. The matrix coefficients are calculated here for certain terminal conditions. The mode of grounding the control strip can be changed by switching (by means of p-i-n diodes). With the control strip grounded at the output end of the line, the C-section has the phase-frequency characteristic of a bandstop filter. With the control strip grounded at the input end of the line or at both ends, the C-section has the phase-frequency characteristic of an all-pass filter. Figures 4, tables 1, references 5: 4 Russian, 1 Western.

EXPERIMENTAL INVESTIGATION OF A PLANAR ACOUSTICO-OPTICAL DEFLECTOR

GUDZENKO, A. I., DERYUGIN, L. N., ZABUZOV, S. A., KLUDZIN, V. V.,
OSADCHEV, L. A., SIROTIN, G. F., SOTIN, V. YE., RAZZHIVIN, B. P. and
TISHCHENKO, A. A.

/Abstract/ The paper gives the results of an experimental study of an acous-
ticooptical deflector based on planar thin-film waveguides. Interaction
between an acoustic surface wave and an optical surface wave propagating in
the same direction or opposite to one another leads to emission of diffracted
light into the substrate. The deflector is shown in the diagram.
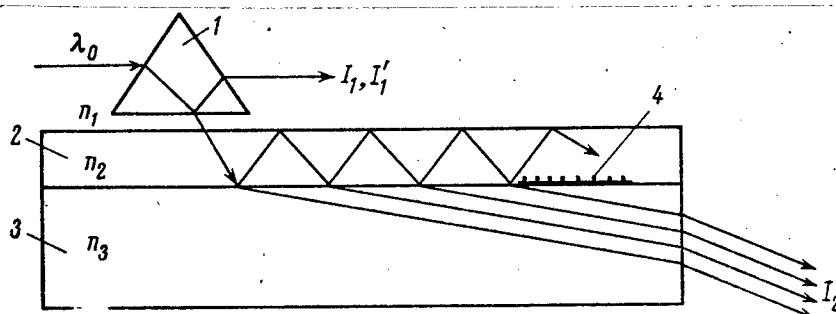
Key:  1- stimulating prism
      2- supporting layer of the optical waveguide
      3- substrate
      4- metal thin-film two-phase grating

The substrate is YX-cut piezoelectric quartz carrying a two-phase grating
with an aperture of 10 mm made up of 20 pairs of electrodes covered by a
polystyrene film 0.445 $\mu$/m thick for excitation of surface acoustic waves.
The optical surface waves traveling in the opposite direction were excited
by a glass prism on a frequency corresponding to wavelength $\lambda_0$ = 0.6328 $\mu$m
in free space. The film thickness results in two modes of optical surface
waves in the waveguide -- $TE_1$ and $TM_1$ with small delays, so that light is
emitted into the substrate on the comparatively low frequency of the acoustic
surface wave (about 30 MHz). As the acoustic surface wave frequency changes
from 29.2 to 30.2 MHz, scanning of the maximum of light emission into the
substrate is observed in the sector of angles from $1°50'$ to $2°17'31''$
measured from the plane of the waveguide. The experimentally measured
efficiency of radiation of light into the substrate was $\eta$ = 40% with high-
frequency voltage of 120 V across the electrodes of the acoustic surface
wave exciter. The efficiency of radiation of light was determined from the

expression $\eta = \dfrac{I_2}{I_1 - I_1'}$ , where $I_1'$ and $I_1$ are the intensities of the
light beams reflected from the base of the exciting prism in resonance and
far from resonance respectively, and $I_2$ is the intensity of the emitted
light beam.  In addition, excitation of optical surface waves was observed
in the waveguide with diffraction of an external light beam by acoustic sur-
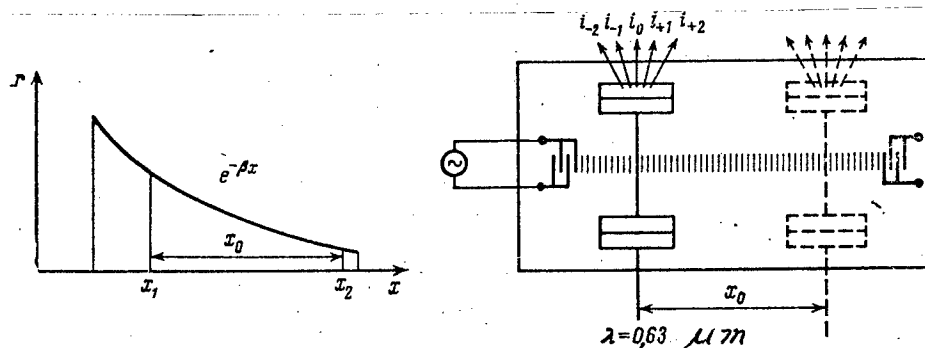face waves.  Figures 1, references 4: 3 Russian, 1 Western.

OSADCHEV, L. A. and SOTIN, V. YE.

/Abstract/  Acoustic surface wave losses are measured by using the acoustico-
optical effect that arises when the wave interacts with an optical waveguide
wave.  The technique is illustrated in the diagram.

The high-frequency voltage applied across the electrodes of the piezoelectric
transducer is held constant, and the ratio of intensities of the beams of
m-th and zeroth orders is measured at points $x_1$ and $x_2$ separated by a dis-
tance $x_0$ in the direction of propagation of the acoustic wave.  This method
was used for measuring losses of an acoustic surface wave in a waveguide con-
sisting of a polystyrene film on a piezoelectric quartz substrate.  For a
film thickness of 1.1 $\mu$m the losses of the acoustic wave did not exceed 0.21
dB/cm.  The measurements were made on a frequency of 29 MHz with voltage
across the transducer electrodes of 50 V.  The efficiency of acoustico-
optical diffraction was 74 and 80% for TE and TM modes respectively.  The
authors thank L. N. Deryugin for constructive criticism and interest in the
work.  Figures 2, references 5: 1 Russian, 4 Western.

CALCULATION OF THE CRITICAL FREQUENCIES AND THE PHASE CONSTANT IN AN
ELLIPTICAL WAVEGUIDE WITH SINUSOIDAL CORRUGATION

BELOV, YU. G.

/Abstract/ Nowadays flangeless feeder channels are built with flexible
corrugated elliptical waveguides. The dispersion characteristics of such a
waveguide are analyzed. The dispersion equation is derived by the impedance
method, for the case of ideally conducting waveguide walls and a relatively
small corrugation amplitude. The boundary-value problem reduces to an
infinite system of linear homogeneous algebraic equations and leads to Mathieu
functions of the k-th order. The solution is convergent in various approxi-
mations and, consequently, the most practical one may be selected. Accord-
ingly, the critical frequencies and the phase constants of modes $HE_{II}^{even}$ and
$HE_{II}^{odd}$ are calculated on the basis of three space harmonics and three eigen-
functions for waveguides with various geometrical proportions. The corruga-
tion period is found to affect the critical frequencies of both modes, the
phase constant of the even mode much less than the corrugation amplitude.
Figures 4, tables 3, references 5: 4 Russian, 1 Western (in translation).

CHARACTERISTICS OF A PLANE OPTICOACOUSTIC DEFLECTOR WITH COLLINEAR PROPAGA-
TION OF OPTICAL AND ACOUSTIC SURFACE WAVES

GUDZENKO, A. I. and DERYUGIN, L. N.

/Abstract/ A deflector is analyzed with operates on the principle of inter-
action between optical and acoustic waves propagating in collinear directions
inside an asymmetrical plane thin-walled dielectric waveguide. Its basic
characteristics are established in accordance with the theory of scanning
antenna arrays, inasmuch as the radiating system consists of an equidistant
array with a period equal to the length of acoustic surface waves and with
a sinusoidal distribution pattern. These basic performance parameters include:
1) Directions of the intensity peaks, 2) Maximum possible angular sector of
single-beam scanning, 3) Angular shift of an intensity peak, 4) Frequency
sensitivity of such a shift (independent of the acoustic frequency but

dependent on the dispersion of acoustic surface waves as well as on the slowdown of optical surface waves and on the spatial orientation of the beam, 5) Doppler shift of the optical frequency during scanning, 6) Resolution, and 7) Beam widening during a linear sweep. Figures 2, references: 7 Russian.

ANALYSIS OF THE MULTIMODAL PERFORMANCE OF A TWO-LAYER CIRCULAR WAVEGUIDE

SMORGONSKIY, V. YA. and ILARIONOV, YU. A., Gorkiy Polytechnic Institute

/Abstract/ A method is proposed for determining the higher modes which can propagate, within a given frequency range, through a two-layer waveguide with given filler parameters. The procedure is based on solving the dispersion equation graphically, rather than numerically. It is applied here to a waveguide with a dielectric rod and a waveguide with a dielectric sleeve. Figures 3; references: 2 Russian.

HYBRID MODES IN OPEN METAL-DIELECTRIC WAVEGUIDES OF COMPLEX CROSS SECTION

YASHKIN, A. YA. and TOMAS, N. N., Moscow State Pedagogical Correspondence Institute

/Abstract/ The phase dispersion of hybrid surface modes in metal-dielectric butterfly waveguides, with two planes of symmetry in the cross section, is calculated here by the method of electrodynamic analogs and paired integral equations, rather than by the method of undetermined coefficients. The dispersion equation and the dependence of the phase retardation on the basic waveguide geometry were evaluated on a computer. Numerical results are shown and interpreted here for the fundamental as well as a few higher modes in a cylindrical waveguide with a cross section regular along the axis. Figures 9, references: 4 Russian.

INVESTIGATION OF IMMERSED DIFFUSIVE OPTICAL WAVEGUIDES

ZOLOTOV, YE. M., KISELEV, V. A., PELEKHATYY, V. M., PROKHOROV, A. M., CHERNYKH, V. A., and SHCHERBAKOV, YE. A., Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

/Abstract/ Diffusive waveguides which are widely used in integrated optics have low losses, because of a smooth transition between waveguide layer and substrate. The losses should become still lower with a smooth transition of the upper surface of the waveguide layer, i.e., upon immersion of the waveguide layer in the substrate so that the maximum increment of the refractive index will occur at some depth. Such waveguides are usually produced by successive electro- and thermodiffusion of ions with high and low polarizability. In this study specimens were produced in glass. The spectrum of their effective refractive index was measured and the increment of this index as a function of the waveguide depth, i.e., their profiles have been identified by successfully approximating them with a parabola above a certain depth and an exponential below it. A close analytical approximation has also been obtained for the difference between the effective refractive indexes for two adjacent modes. Figures 3, references 3: 1 Russian, 2 Western.

NUMERICAL ANALYSIS OF DIRECTIONAL WAVES IN A PLANE DIELECTRIC WAVEGUIDE

KAPILEVICH, B. YU.

[Abstract] A plane dielectric waveguide inside another medium is considered. The field of E-waves and the field of H-waves are determined by a successive solution of two first-order differential equations and a subsequent application of the Runge-Kutta method for numerical results. The normalized propagation constants of even and odd waves have thus been computed for a typical non-magnetic waveguide inside a nonmagnetic medium. The same procedure can be followed for computing the critical frequencies. Figures 2, references 4: 1 Russian, 3 Western (one in translation).

EXCITATION OF HYPERSOUND BY RESONATORS ON AN OVERRANGE WAVEGUIDE

VLASOV, A. B. and PLYUTO, V. S.

[Abstract]  Experiments have demonstrated the feasibility of exciting hypersound
by resonators on an overrange waveguide.  This combines the advantage of struc-
tural simplicity with that of direct coupling to the waveguide channel.  Measure-
ments were made with waves in the decimeter range and the coefficient of electro-
magnetic-to-acoustic energy conversion found to be maximum in a rectangular
waveguide with sides $\partial = (0.33-0.37)\lambda_{res}$ and b= $(0.07-0.09)\lambda_{res}$.  These values
not being very critical, however, standard waveguide sections could be used.
The feasibility of wideband excitation in an overrange waveguide was, further-
more, tested with a chain of eight resonators coupled and installed on a
single segment.  With the proper spacing, satisfactory results were also
obtained.  Figures 2, references:  7 Russian.

PARAXIAL WAVE BEAMS IN REGULAR AND IRREGULAR WAVEGUIDES

UFIMTSEV, P. YA. and YAKOVLEVA, G. D.

[Abstract]  The authors use a series of model problems as an example to
demonstrate that a parabolic equation properly describes the propagation of
paraxial wave beams in regular and irregular waveguides.  They propose a
new variation for the method of the parabolic equation, called the method
of the reference wave, which they recommend for numerical investigation of
the paraxial wave beams in irregular waveguides with a complex shape to the
cross section.  Figures 4, references 32:  26 Russian, 6 Western.

SOME PECULIARITIES OF THE PROPAGATION OF WAVES IN WAVEGUIDES WITH A
RESISTIVE FILM

KALMYK, V. A., PAVLOVSKAYA, G. V. and RAYEVSKIY, S. B., Gor'kiy Polytechnical
Institute

/Abstract/ The properties of waves propagating in waveguides with resistive
films have certain peculiarities. Because the thickness of the resistive
films placed in the waveguides is usually less than the thickness of the
skin layer, approximate methods have been used to study the dispersion
properties of such waveguides -- the surface current method, which can be
reduced to describing the discontinuous boundary layer for the magnetic field
on the resistive film. This work studies the dispersion properties and dis-
tribution of the $HE_{11}$ wave field in a rectangular waveguide separated into
two parts by a longitudinal resistive film, which generally produces a
hybrid field. Some of the peculiarities of propagation of waves in wave-
guides with resistive inclusions are explained. One interesting peculiarity
of waves in waveguides with resistive films can be determined by comparing
characteristics of various types of waveguides. In a circular, two-layer
waveguide with a resistive film between the layers, the attenuation of the
$E_{01}$ wave increases with increasing surface resistance of the film. Con-
versely, in a rectangular waveguide with a film, the attenuation of the $H_{10}$
and $HE_{11}$ waves decreases with increasing resistance. This is explained by
the fact that in the former case there are only longitudinal currents in the
film, whereas in the latter case there are either only transverse currents
($H_{10}$ wave) or the transverse currents, as is indicated by the field distri-
bution, dominate over the longitudinal currents ($HE_{11}$ wave. Figures 5,
tables 1, references 14: 11 Russian, 3 Western.

PROPAGATION OF LIGHT BEAMS THROUGH THIN-FILM WAVEGUIDES

GONCHARENKO, A. M., KARPENKO, V. A., and SMOLYAROV, YU. D.

/Abstract/ A translucent and nonmagnetic film is considered whose dielectric
permittivity is a function of one space coordinate only. The Maxwell field
equations are solved for Gaussian waves, and the possible field distributions
in such a waveguide are examined. The effect of nonuniform weak absorption

on the propagation is then also taken into account and found not to affect the field distribution in the waveguide. Theoretical and experimental results are compared on the basis of macroscopic microwave models made of such materials as polystyrene and Teflon. The effect of spatial boundedness on the refractive index and its dispersion has been evaluated in this way. The authors express sincere thanks to B. A. Sotskom for helpful discussions of the results of the work. Figures 1, references 12: 6 Russian, 6 Western.

POSSIBILITY OF RECORDING LIGHT WAVEGUIDES BY MEANS OF LASER AND ELECTRON BEAMS IN THIN FILMS OF VITREOUS CHALCOGENIDE SEMICONDUCTORS

REMESNIK, V. G., FATEYEV, V. A. and TSUKERMAN, V. G., Institute of Automation and Electrometry, Siberian Affiliate, Academy of Sciences USSR, Novosibirsk

/Abstract/ First results are presented on the formation of directed light waveguides in vitreous chalcogenide semiconductor (VCS) layers by means of laser and electron beams. The experiments involved atomized $As_{20}S_{80}$ films 0.4–6 $\mu$ m thick with index of refraction n = 2.25, excited by radiation at wavelength $\lambda$ = 0.63 $\mu$m. The percent composition of the As=S system was selected as that having the minimum light energy loss factor for the wavelength in question. It was found that excitation of the waveguide layer at an angle other than 90° leads to spatial separation of the spectrum of the excited modes of different orders as to propagation angle. This fan effect results from the fact that modes of different orders have different effective indices of refraction. If the maximum variation of index of refraction in the films is used, waveguides can be produced with bends with radii of 0.1 mm with light energy loss factors of 0.2 dB/cm. Figures 3, references 7: 2 Russian, 5 Western.

WAVEGUIDE STRUCTURES AND FUNCTIONAL ELEMENTS OF INTEGRATED OPTICAL CIRCUITS BASED ON THREE-DIMENSIONAL HOLOGRAPHIC GRIDS IN THIN $As_2S_3$ FILMS

ANDRIYESH, A. M., BYKOVSKIY, YU. A., KOLOMEYKO, E. P., MAKOVKIN, A. V., SMIRNOV, V. L. and SHMAL'KO, A. V., Moscow Institute of Engineering and Physics

/Abstract/ Thin films of amorphous chalcogenide semiconductors are a new and interesting material for use as recording media in holography and in optical information processing devices because of their capability for recording of holograms with high diffraction effectiveness (over 80 percent), their resolution of about $10^4$ lines per millimeter and memory duration over 2500 hours. A study is made of functional integrated optics elements based on three-dimensional holographic phase grids in thin-film optical waveguides. Arsenic trisulfide films are used as the waveguides. Sinusoidal phase grids are constructed in the volume of the thin-film waveguides, performing the function of reflection and transformation of surface waves. A thin-film reflecting grid filter is created with a half band width of about 2.5 A with a maximum reflection factor of 0.9. The calculated parameters of the grid structures agree satisfactorily with the experimental data. $As_2S_3$ was selected as the medium for the experiments because its area of transparency lies in the 0.6-11 $\mu$ m band and films of this material have the least losses of all chalcogenide materials. The grid structures can operate in the dynamic mode, opening broad possibilities for the creation of active control devices for integrated optical devices. Figures 6, references 17: 8 Russian, 9 Western.

PROPAGATION OF NATURAL WAVES THROUGH MULTILAYER OPTICAL WAVEGUIDES. PART 3: WAVEGUIDES WITH NEGATIVE WAVEGUIDE DISPERSION AND STRONG FILTRATION OF HIGHER MODES

BELANOV, A. S. and DIANOV, YE. M., Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

/Abstract/ Five different circular three-layer dielectric optical waveguides are analyzed on the basis of the characteristic equation and the dispersion characteristics. They all consist of a core currounded by a shell of a definite thickness and a lower optical density. This shell is surrounded by

a second one with an arbitrary refractive index and of a thickness suffic-
iently large to eliminate the effect of the ambient medium on the parameters
of natural waves through the waveguide. Strong filtration of parasitic
higher modes is achieved by utilizing the favorable trend of thermal and
radiation losses. The negative waveguide dispersion partly compensates the
positive material dispersion and thus makes it possible to maximize the
bandwidth of transmitted pulse signals. Figures 5, references 8: 6 Russian,
1 German, 1 Western.

SCATTERING CHARACTERISTICS OF A NARROW LONGITUDINAL SLIT IN A RECTANGULAR
WAVEGUIDE

FRIDBERG, P. SH.

/Abstract/ The author considers two single-mode rectangular waveguides with
infinitely thin and ideally conductive walls coupled through a narrow longi-
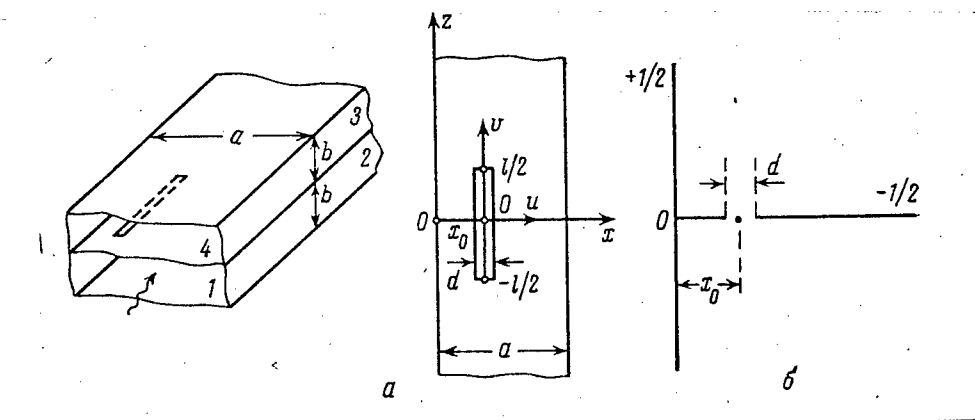tudinal slit (see the figure).



Figure 1

It is assumed that $d/L \ll 1$, but $\ln (L/d) \sim 1$, where L is the characteristic
dimension in the problem. The scattering characteristics of the slit are
determined, and numerical results are plotted on graphs. It is found that
slits that are not excessively long ($l < 0.5 \lambda$) are practically non-
directional. Figures 4, references: 8 Russian.

DIFFRACTION OF AN $E_{01}$ WAVE AT THE JOINT BETWEEN HOLLOW AND TWO-LAYER
CIRCULAR WAVEGUIDES

SMORGONSKIY, V. YA. and TIMOFEYEV, YE. P.

/Abstract/ The authors calculate and study the main electrodynamic character-
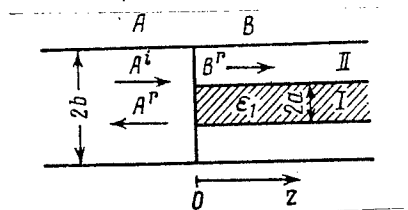istics of the interface between two different waveguides as shown in the
diagram.



Figure 1

The hollow cylinder A butts up against the two-layer rod B, permittivity $\varepsilon_1$
being taken as real ( $\varepsilon_1 > 1$). It is assumed that the incident $E_{01}$ wave
propagates in the positive direction of the z-axis in waveguide A, and
diffraction between the tube and the rod is studied over a wide range of
frequencies for different filler parameters (a/b, $\varepsilon$ ). The field in the
vicinity of the joining is represented as a superposition of modes $E_{0n}$, the
field in the tube being taken as the sum of the incident and reflected waves,
while that in the rod is taken as the sum of the transmitted modes only.
Analysis of expressions for calculating the characteristics of incidence,
reflection and transmission at the interface shows that it is sufficient to
take 4-5 normal modes into account, and that a further increase in the number
of waves will not improve accuracy. Frequency response curves are given for
the coefficients of reflection and transformation of modes $E_{0n}$ with n = 1, 2,
3 for the coefficient of reflection as a function of the coefficient of fill-
ing a/b of the rod waveguide, and also as a function of the permittivity.
It is found that the coefficient of reflection at the joining passes through
a maximum when the parameters of the two-layer waveguide are $\varepsilon = 5$, a/b $\sim$
0.35. Assuming that the required coefficient of reflection is given, these
curves can be used for optimum choice of the rod parameters. Figures 6,
references 3: 1 Russian, 2 Western.

INSTABILITY OF A BEAM OF RELATIVISTIC ELECTRONS IN A DIAPHRAGM-TYPE WAVE-
GUIDE   I.   GENERAL STATEMENTS, SMALL SPACE CHARGE

NECHAYEV, V. Ye., Scientific-Research Institute of Radiophysics

/Abstract/ Small oscillations in relativistic electron beams (REB) are
studied with arbitrary distribution of concentration N(r) over the radius
of the beam, assuming unperturbed motion along the axis at a single velocity.
The magnitude of the magnetostatic field $H_{0z}$ is assumed to be arbitrary.
Furthermore, in producing the dispersion equations, the potential portion of
the field is taken into consideration, because it is not always correct to
ignore this portion of the field, particularly for high-current beams.  A
general method is developed for the production of dispersion equations with
an assigned longitudinal wave number for single-velocity REB in retarding
waveguides.  For the cases when nonresonant fields can be ignored (small space
charge), areas of instability are found and increments of symmetrical and
asymmetrical oscillations calculated with various values of the focusing
magnetostatic field.  In almost all of the cases studied, instability is
of drift type, i.e., the energy of a wave packet increases as time passes in
a system moving with the group velocity, while in the laboratory coordinates,
in spite of the time build-up of the "quasimonochromatic" wave with one h,
the field of the entire packet may increase in space, but not in time.  It is
emphasized that the establishment of the fact of time instability of waves
is a sufficient indication that the wave fields extract energy from the
electrons, i.e., disrupt the beam.  The results indicate that a strong axial
magnetic field significantly stabilizes the beam, primarily eliminating
asymmetrical disruptions.  References: 5 Russian

WAVEGUIDE LOAD WITH A DIAGONAL DISPOSITION OF THE RESISTIVE FILM

KHARITONOV, A. A.

/Abstract/ In microwave measuring devices one uses matched waveguide loads
with an SWR close to unity and, because the power level is low, thin-film
resistors seem particularly suitable for this application.  The resulting
SWR would then be higher than unity, however, because of the additional
structural components needed to prevent vibrations and acting as parasitic

reflectors. Experiments have demonstrated the feasibility of achieving an SWR = 1.03-1.01 by means of dielectric wedges as the substrate for the resistive film so that the latter will be disposed diagonally inside a waveguide rather than parallel to its narrow wall. The performance characteristics of such a waveguide have been measured, namely its SWR as a function of the relative wedge length and as a function of the generated wavelength. Figures 2, references: 2 Russian.

ON THE COMPUTATION AND USE OF DIELECTRIC RESONATORS IN MICROWAVE DEVICES

ALEKSEYCHIK, L. V., GEVORKYAN, V. M., KAZANTSEV, YU. A. and KALUGIN, YE. I.

/Abstract/ The authors compute the induced oscillations of miniature dielectric resonators. The approximate analytical solution to the problem is based on dividing the field of the examined resonator into resonance and nonresonance parts, the first of which is determined from the theorem on overall strength and the second is a quasistatic approximation. They obtain analytical expressions for the matrices of scattering of a dielectric resonator in different types of microwave transmission lines in a broad frequency range and compare the results of theory and results from the experimental investigations. They analyze the features of using the dielectric resonators in passive microwave devices. The authors thank L. A. Vaynshteyn for discussion of the work. Figures 5, references 10: 7 Russian, 3 Western.

ENERGY CAPACITY OF AN ELECTRON BEAM IN A RESONATOR WITH A TRANSVERSE FIELD

BARDENKOV, V. A., VANKE, V. A. and SAVVIN, V. L.

/Abstract/ A microwave system is analyzed where a half-wavelength distribution of the high-frequency field ensures, with maximum transit angles, a minimum energy transfer at the ends of the capacitive excitation space. With the field in the interaction space assumed to be a TEM standing wave, the maximum power is calculated which can be imparted to the electron beam. In the nonrelativistic case the system is assumed to be linear and in the

relativistic case the equation of motion is integrated numerically. The same procedure applies to the reverse mode of operation, namely demodulation of the electron beam. Figures 2, references 9: 5 Russian, 4 Western.

FEATURES OF HETEROGENEOUS ONE-DIMENSIONAL DIELECTRIC RESONATORS OF SPECIAL TYPE

BUDAGYAN, I. F., MIROVITSKIY, D. I. and USATYUK, V. V.

[Abstract]  The authors find the solution for a field, the internal coefficient of reflection and the input resistance of a heterogeneous one-dimensional dielectric resonator with a fractional-linear profile.  They study the features of resonators of this type and analyze them.  By extrapolating the results obtained for the heterogeneous one-dimensional fractional-linear resonator to two-dimensional problems the authors were able to predict the possibility of designing dielectric waveguides which are heterogeneous in the lateral direction, including asymmetric ones which have a number of features including the possibility of operating on a basic type of wave with a quite thick plate by increasing the scatter in neighboring resonance frequencies, a significant increase or decrease in thickness of the waveguide, etc.  Figures 6, tables 1, references 6:  3 Russian, 3 Western.

SYNTHESIS OF SYMMETRICAL PLANE DIELECTRIC WAVEGUIDES

ANDRUSHKO, L. M. and LITVINENKO, O. N.

/Abstract/  Plane waveguides for operation at microwave or optical frequencies are considered in which the dielectric permittivity depends only on the thickness coordinate.  First, the fundamental equations of TE modes are solved for a dielectric film with either an electric or a magnetic shield through the center plane.  The proper variation of the dielectric permittivity across the thickness is then synthesized for a prescribed spectrum of cutoff frequencies, i.e., with given frequency and attenuation dispersion characteristics

required of the waveguide. The same principle applies to TM modes. A simple practical five-step procedure is evolved and results are shown in the specific case of synthesizing a plane dielectric waveguide where the cutoff frequencies squared of all even and odd modes, but not of the null mode, will be shifted by the same amount upward relative to the spectrum of a homogeneous waveguide. This problem is of practical importance, as it relates to widening the range of single-mode operation. Figures 3, references 24: 18 Russian, 6 Western (one in translation).

CALCULATION OF THE REFLECTION COEFFICIENT AT THE JUNCTION BETWEEN TWO ELLIPTICAL WAVEGUIDES

BELOZEROV, YU. S. and ILARIONOV, YU. A.

/Abstract/ A junction is considered between two smooth waveguides whose cross sections constitute two confocal ellipses with different eccentricities. The reflection coefficient at this junction is calculated on the basis of the zeroth approximation and the sum of higher-order terms, involving the characteristics impedances with respect to H-waves and E-waves. A numerical solution was obtained on a computer with sixteen terms only, yielding an accuracy within 0.02 percent. The results indicate that the modulus of the reflection coefficient increases with decreasing wavelength. Figures 1, references 5: 2 Russian, 1 Western (in translation), 2 German.

CZECHOSLOVAKIA                          UDC 621.372.832.8

CIRCULATORS FOR MICROWAVE INTEGRATED CIRCUITS

SAKALA, ONDREJ; TESLA - A.S. POPOV Research Institute for Telecommunication
Engineering, Prague

/Abstract/ A review of characteristic properties and operation principles
of Y type ferrite strip circulators is presented. Experimental work under-
taken in this field by the author and others at TESLA was used for the
development of a method for the design of broad-band microwave circulators
using exclusively materials and components of Czechoslovak production. The
corundum substrate material was 99.75 percent $Al_2O_3$ prepared at the pilot
plant of the Research Institute for Electrical Engineering at Hradec Kralove;
the ferrite discs were made of ferrite produced in the pilot plant of TESLA.
The magnetic operation fields used an open magnetic circuit of a single
permanent magnet, located below the earthed substrate plate. The magnet was
provided with a continuous regulation of the magnetic field. The magnets
were made of the Sm Co Cu type material and of the Sm $Co_5$ type. The problems
of the attachment of the ferrite discs to the corundum substrate were solved
experimentally in TESLA laboratories. The circuits use a co-axial micro-
strip design. Leakage losses did not exceed one dB and insulation values
exceeded 20 dB. Figures 9, references 19: 3 Czech, 1 Russian, 15 Western.

QUASI-OPTIMUM REFLECTOR-CORRECTOR IN A WAVEGUIDE BEND

BARSKIY, I. I. and VAGANOV, R. B.

/Abstract/ For passing the symmetric $H_{01}$-mode across a bend in a circular
waveguide and suppressing the parasitic modes in the process, a cylindrical
reflector is proposed which curves in the plane of the waveguide bend and
which compensates the phase distortions caused by diffraction at its aperture.
The open ends of the waveguide are regarded as the transmitting and the
receiving surface, respectively, with the corrective reflector between them
at a 45° angle. The performance characteristics are calculated on the basis
of various mathematical approximations and compared with experimental data
for a particular design. The authors thank B. Z. Katsenelenbaum for spon-
soring the work. Figures 3, references 9: 6 Russian, 3 Western.

REALIZABILITY CONDITIONS AND BASIC PROPERTIES OF SYMMETRICAL EIGHT-ARM
WAVEGUIDE BRIDGES

SKRYPNIK, L. V.

[Abstract] An eight-arm bridge is a microwave multipole network consisting of
two groups of decoupled arms (four in each) where power fed to any one arm of
one group divides equally and without reflection between all four decoupled
arms of the other group. The geometry of such devices is characterized by
three orthogonal planes of symmetry. This is taken into account in the calcula-
tion of the scattering matrix and its coefficients, from which in turn the
conditions of equal power division are derived. These conditions serve as
the design criteria, inasmuch as they determine the geometrical proportions
of such a device. An eight-arm bridge was built experimentally according to
the thus established criteria and found to perform satisfactorily also in
terms of very weak coupling as well as very weak reflection. Figures 2,
tables 1, references 6:  2 Russian, 4 Western.

USSR UDC 621.372.851

COUPLING OF RECTANGULAR WAVEGUIDES THROUGH AN OVERRANGE SEGMENT

KABAKOV, L. T.

/Abstract/ A microwave joint in the form of a small hole through a current-conducting shield of finite thickness may be regarded as an overrange segment of the waveguide. Such joints are finding wider use especially in miniature microwave filter systems. Here a joint of finite length and with an isotropic homogeneous dielectric filler between two rectangular waveguides is analyzed, with the longitudinal axes of both waveguides assumed to be coplanar and the joint axis either parallel to both or perpendicular to one of them. The field amplitude factors and the admittance coefficients have been calculated according to Galerkin's variational method. The coefficients of the scattering matrix, yielding the insertion losses, have been evaluated on a digital computer for an attenuator-pickup device, and an error analysis indicates a sufficiently close agreement with measurements. The amplitude-frequency characteristic and its nonlinearity have also been evaluated. These results provide the basis for a rational design of frequency-selective probes. Figures 5, tables 1, references: 5 Russian.

USSR UDC 621.372.833.1

OPTICAL PROCESSES IN THIN-FILM LASERS AND WAVEGUIDES WITH ARBITRARY
DISTRIBUTION OF INDEX OF REFRACTION

KISELEV, V. A. and PROKHOROV, A. M., Physics Institute imeni P. N. Lebedev,
Academy of Sciences USSR, Moscow

/Abstract/ A theory is developed for planar waveguide systems with arbitrary distribution of the index of refraction through the transverse cross section. The theory encompasses diffraction transformation of surface light waves, gradual transformation of one light wave to another, resonant reflection of a surface wave to an oppositely directed wave of the same or of a different order, diffraction input and output of radiation from waveguides, resonant mutual conversion of surface waves of second diffraction order and diffraction radiation (and excitation) of a surface wave in the first negative order. Diffraction transformations of surface waves occurring in the first diffraction order are analyzed in detail. The relationships describing each

process are formulated as applicable to planar waveguides with arbitrary transverse distribution of the index of refraction. All processes are studied for both possible polarizations of light, i.e., for H as well as E waves. In particular, conditions for generation of H and E waves in thin film lasers with distributed feedback and arbitrary transverse distribution of index of refraction are formulated. Figures 2, references 6: 4 Russian, 2 Western.

IL'CHENKO, M. YE. and MIRSKIKH, G. A.

[Abstract] Single-crystal ferrite and open dielectric resonators are usually coupled to transmission lines through loops. Such a system on n (n= 3) crossing loops is analyzed here, each loop consisting of a linear conductor bent into a circular arc in a plane perpendicular to a plane common to all, with a resonator at the common geometrical center. First, the general impedance matrix is derived, in the case of H-modes, from the Biot-Savart law with various simplifying assumptions. In one variant each loop is connected to one transmission line, and in another variant each loop is connected to two transmission lines. Then the scattering matrix is obtained for various specific simple resonator systems, and its coefficients are calculated. Calculated maximum and minimum insertion losses as well as the amplitude-frequency characteristics of a typical four-arm orthogonal two-semiloop array with a spherical ferrite or dielectric disk resonator, operating as a bandpass or bandstop filter, are found to agree closely with the results of measurements. Figures 5, tables 1, references 11: 8 Russian, 3 Western.

LOW PASS FILTERS WITH MONOTONIC TRANSIENT RESPONSE CHARACTERISTICS

AKINFIYEV, N.N. and ZHAROVA, S. S.

/Abstract/ The general theoretical questions of low pass filters with mono-
tonic transient characteristics are treated, and the problem of minimizing
the width of the pulse response of a strictly frequency-limited filter of
this type is solved for the case of a mean square quality criterion.  A
class of functions is defined which permits the representation of the trans-
fer functions of a circuit so as to satisfy the necessary and sufficient
conditions for the monotonicity of the transient response; the problem of
determining the characteristics of an optimum filter of this type is solved
and nine theorems are presented for the phase characteristic, transfer func-
tion and the pulse response of the optimum filter.  Figures 2, tables 1,
references 12: 11 Russian, 1 Western.

CALCULATION OF NONRECIPROCAL DEVICES FOR THE SUBMILLIMETER BAND

KATS, L. I., POPOV, V. V. and REVZIN, R. M.

/Abstract/ The principles of passive nonreciprocal devices based on using
the properties of a magnetically active solid-state plasma in waveguides are
explained, and the feasibility of developing such devices for the submilli-
meter and the shortwave part of the millimeter band is discussed.  The
analysis is based on a plane-parallel waveguide ($\partial/\partial x = 0$) partly filled
with a magnetically active plasma formed by the charge carriers in a semi-
conductor, as shown in the figure.
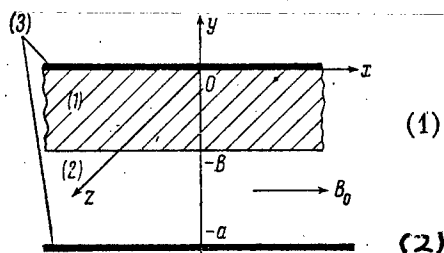


Partly filled plane-parallel waveguide
Key: (1) semiconductor; (2) vacuum; (3) ideally conductive plates

It is assumed that the waveguide height $a$ satisfies the condition $a \ll \lambda_0/\sqrt{\kappa}$ ($\lambda_0$ is the wavelength in free space, $\kappa$ is the relative permittivity of the crystal lattice of the semiconductor). Equations are given for the components of the permittivity tensor and the longitudinal-electric (LE) and longitudinal-magnetic (LE) wave modes. It is shown that the limitation on the waveguide height eliminates the LE wave, and therefore the analysis is restricted to the extraordinary (LM) wave. The asymptotic behavior of wave propagation for fast waves and slow waves is considered. Curves for the effective permittivity $\kappa_{ef}$ as a function of the external magnetic flux density in different frequency bands show that $\kappa_{ef}$ varies considerably, resulting in an appreciable change in the spectrum of normal modes of the system as a function of the external magnetic field. Systems of equations for determining the complex propagation constant $\kappa_z$ are examined for two cases: 1) $\kappa_{ef} \ll -\kappa$, and 2) $-\kappa \lesssim \kappa_{ef} \lesssim \kappa$. It is shown that the analogous system for a thin plasma layer that causes weak perturbation of a TEM wave in a plane-parallel empty waveguide takes an especially simple form that permits an explicit solution. Curves are given for the basic characteristics of the model as a function of frequency and external magnetic field, demonstrating the feasibility of passive nonreciprocal elements in the submillimeter band at emission frequencies in excess of the plasma frequency. Figures 5, references 8: 4 Russian, 4 Western.

SIGNAL PROCESSING WITH HOMOMORPHIC SYSTEMS

HUSZTY, GABOR, Research Institute of the Postal Service

/Abstract/ The author reviews, on the basis of references in the literature,
the theoretical fundamentals and properties of homomorphic systems in general
and multiplicative homomorphic filters in particular. The review includes
an unconventional compandor which may be useful in the processing of speech
signals. From examples published in the literature it is demonstrated how
multiplicative homomorphic filters may be used to separate nonlinearly com-
bined (for example, multiplied) signals into their components and then to
recombine the signals after transformation of the components once again.
Such combined signals are often encountered in communications technology,
for example amplitude-modulated signals and also speech signals. In these
signals, one component is a rapidly changing bipolar signal and the other
component is a slowly changing positive signal. An appendix describes
algebraic structures related to the subject matter. Figures 16, references
16: 7 Hungarian, 9 Western.

THEORY OF THIN CONDUCTORS INSIDE A CAVITY RESONATOR

YUROV, YU. YA. and DMITRIEV, YU. S.

/Abstract/ The currents flowing through conductors inside a microwave
resonator are calculated by first assuming these conductors to be located
in free space and then accounting for the effect of the resonator walls in
terms of extraneous fields. These are expanded into a vector Fourier series
in resonator eigenfunctions and the coefficients of this series are found
to have resonance characteristics, which renders the proposed method very
suitable for engineering calculations. References:12 Russian.

SYNTHESIS OF RESONATORS BASED ON TRANSMISSION LINES WITH TUNING BY SMOOTH
STEPS

SHARAPOV, V. V., Minsk Radio Engineering Institute

/Abstract/ The synthesis is considered of resonators with varactor diodes.
In the process of synthesis, the main parameters of a resonator with tuning
in smooth steps (RTSS) are determined on the basis of an impedance method.
Recurrence expressions for the input conductance of the resonator are derived
that enable one to carry out the procedure of resonator synthesis on the
basis of Muller's method. An algorithm is presented for synthesis of a
resonator with RTSS that is based on the derived expressions. Synthesis of
a RTSS was conducted for the most often occurring values of the parameters
of varactors and lines in the frequency range to 4 GHz. The results obtained
make it possible to determine the dependence of the frequency characteristics
of RTSS on the number of varactors included in it as well as the structural
coefficients for the inclusion of diodes for various values of the equivalent
circuit of RTSS.

DISTRIBUTION OF AN ELECTRIC MICROWAVE FIELD IN N-TYPE SILICON NEAR A
METALLIC CONTACT

DENIS, V. I., SKUCHAS, YU. P. and YARMALIS, M. M.

/Abstract/ A study was made concerning the extent to which a metallic con-
tact tab deposited on a semiconductor slab inside a waveguide channel dis-
torts the distribution of a microwave field in that semiconductor. Measure-
ments were made on an n-type silicon slab with the electrical resistivity
$P$ = 200 $\mathcal{S}\mathcal{b}$ .cm inside a waveguide with a 72x34 mm$^2$ cross section and with an
$H_{10}$-mode field. Metal foil at the end of a Teflon rod was pressed against
and moved over the slab surface, acting as a probe whose change in resistance
because of electron heating in the microwave field produced a proportional
voltage signal. The applied electric microwave field was $E_m$ = 20 V/cm
strong. A foil less than 1.0 mm long and wide was found to distort the
microwave field appreciably only within a distance shorter than its dimen-
sions. Figures 3, references 6: 4 Russian, 2 Western.

ELECTRICALLY CONTROLLED MICROWAVE SEMICONDUCTOR-DIODE SWITCHES (SURVEY)

IL'CHENKO, M. YE. and OSIPOV, V. G.

/Abstract/ Following a general classification of microwave semiconductor-
diode switches and their parameters, this survey deals in particular with such
switches of the p-i-n type. Input power and switching speed are established
as their selection criteria, insertion loss and decoupling as their main
design and performance parameters. Supplying the control bias ranks among
the major technological problems. Several variants of two-channel switching
circuits are shown and their respective merits are discussed, in terms of
expanding the frequency range and raising the power handling capability.
Multichannel circuits are considered next, also multiconductor coupled lines
after single-conductor lines. The trend toward integrated-circuit technology
is noted. Figures 3, tables 3, references 41: 21 Russian, 20 Western.

WIDEBAND POWER DIVIDERS BASED ON NONUNIFORM LINES

GORBACHEV, A. P. and ROMANOV, A. N.

[Abstract]  The frequency band of microwave power dividers can be widened and
the power division can be made more uniform by the use of asymmetrical
directional couplers based on nonuniform lines and with a ladder or binary
connection.  The amplitude-frequency and the phase-frequency characteristics
are analyzed, whereupon the coupling function of such a directional coupler
is synthesized.  Numerical values are tabulated.  An experimental four-channel
prototype was designed and built on a printed-circuit board, with shielded
strip lines and a binary coupler connection.  Tests within the decimeter range
of wavelength and a 4:1 overlap yielded a maximum unbalance of power outputs
equal to 0.5 dB and a minimum decoupling between channels equal to 20 dB.
Figures 2, tables 2, references 5:   3 Russian, 2 Western.

CHAIN-TYPE MICROWAVE POWER DIVIDERS BASED ON UNCOUPLED TRANSMISSION LINES

ZAYENTSEV, V. V. and VINOGRADOV, G. A.

[Abstract]  The use of uncoupled transmission lines for chain-type power
dividers simplifies the design by making a planar structure feasible, while
improving the frequency and phase characteristics.  Shorter than 1/4 λ lines
can be used here, resulting in a smaller and more efficient device for opera-
tion at meter  and centimeter wavelengths. Such a multichannel power divider
consists of N two-channel dividers in series, each with decoupled outputs
and unequal coefficients.  No impedance transformation is effected within an
individual segment.  From a practical viewpoint the two most interesting
circuit configurations are:  1) All the capacitances at the end in parallel
with the decoupling impedances, and 2) The capacitances in each segment
connected so far from the beginning of the segment as to make all capacitances
equal, regardless of the number of segments.  On the basis of theoretical
considerations, four-channel power dividers have been developed with thick-
film 1/4 λ lines for the centimeter band and with microstrip 1/16 λ lines on

glass-ceramic substrates for the dead band. Over the relative bandwidth of 0.3 the VSWR is not higher than 1.4 at the inputs and the decoupling is not less than 18 dB. At the center frequency, the VSWR is not higher than 1.05 and the decoupling is not less than 24 dB. The unbalance of power distribution at the outputs does not exceed 5 percent. Figures 3, references: 2 Russian.

ALEKSEYEV, L. V.

[Abstract] Directional couplers are made more effective by the addition of an unloaded intermediate conductor in the immediate vicinity of the main coupler conductors. A theory of such couplers is presented which derives from the theory of conventional couplers and leads to the concept of an "effective" capacitance matrix. This matrix is calculated for the case of symmetrical three-conductor strip lines (the third conductor being the additional one) with various extreme shielding configurations. This theory and method of analysis can be extended to a multiconductor with close coupling, which is of special interest in printed-circuit technology. Figures 4, tables 1, references 7: 1 Russian, 6 Western (two in translation).

NESHKOV, D. Z.

/Abstract/ A procedure is presented for calculating the coupling factor and the directionality of a two wire coupler for a four wire rectangular feeder. A simplified form of the general expression is also presented and the differences between the values of the coupling factor and the directionality computed from the two formulas differs less than 0.3 dB and 0.1 dB, depending on the coupler parameters; the calculated and experimental values of the coupling factor and the directionality are in good agreement within the limits of measurement error. Figures 1, references: 3 Russian.

EXPERIMENTAL INVESTIGATION OF THE FREQUENCY CHARACTERISTICS OF TWO-ELEMENT
FERRITE FILTERS

ROGOZIN, V. V., SLAVIN, A. N. and FADEYEV, A. O.

/Abstract/ Theoretical frequency responses are compared with experimental
data for a two-element microwave filter of orthogonal loop design, as shown
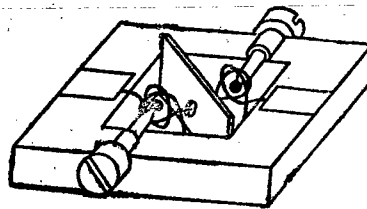in the diagram.

Figure 1

The input and output loops are connected to symmetric input and output
strip lines.  The coupling loops are orthogonal and concentric to the main
loops, and are connected by the same type of wire.  The connecting wire
passes through an aperture in a diaphragm.  Ferrite spheres are held in the
center of the loops, and are magnetized by a permanent magnet along the
axis of intersection of the orthogonal loops.  Experiments were done on
filters with different sizes of the main loops and different coupling lines.
It is found that experimental data agree satisfactorily with calculations
of the coupling parameter.  Figures 2, tables 1, references: 5 Russian.

MICROWAVE FILTERS USING MAGNETODYNAMIC OSCILLATIONS IN A FERRITE SPHERE

IL'CHENKO, M. YE. and MELKOV, G. A.

/Abstract/ The authors investigate microwave filters that utilize the
magnetodynamic oscillations caused by mutual coupling between oscillations
of uniform precession of magnetization intensity and volumetric oscillations
of a spherical ferrite resonator.  Regions are defined for fields of
magnetization where the threshold power levels of the filters are caused

by different processes. Experiments were done on bandpass filters using coupled oscillations in a spherical ferrite resonator with dimensions comparable to the electromagnetic wavelength. Results are given for a filter operating in the 3-cm band with a yttrium ferrite-garnet sphere. The passband was 180 MHz on the 3 dB level. The results showed that unnable ferrite filters operating at kilowatt power levels are feasible. Figures 2, references 6: 3 Russian, 3 Western.

AVERIN, S. V. and POPOV, V. A.

/Abstract/ Use of Schottky-barrier diodes as videodetectors of radiation is analyzed on the basis of a comparison of equivalent circuit diagrams and measurements made within the 115-890 GHz frequency range. Because of the high potential barrier ($\varphi = 0.9$ eV), detection of low power levels requires a dc bias. The voltage-power sensitivity as a function of the bias current is evaluated for an ideal diode and the theoretical optimum performance parameters are established accordingly. A subsequent noise analysis establishes the practical capabilities and limitations of such a diode. The critical noise frequency appears to be about 1 MHz, with 1/f-noise below it and white noise above it. Both a conical and a quasi-optical detector structure were considered. Figures 5, tables 1, references: 9 Western.

MATORA, I. M. and MERKULOV, L. A.

/Abstract/ Design of electron guns for induction linear accelerators is considered. A technique is proposed for determining the configuration of the cathode emitter surface that gives a laminar electron flux. The analysis is based on simultaneous solution of a system of exact equations

of self-consistent motion of electrons in the gun in cylindrical coordinates by a method of successive approximations with computer correction of consecutively modified emitter surfaces resulting from trial calculations of fans of trajectories in the gun until laminar output is achieved. The calculations are done for a gun with current of 250 A and electron energy of 500 keV. The computer program was written in CERN-FORTRAN for the SDS-6400. Figures 5, references 8: 4 Russian, 4 Western.

A TWO-CAVITY RESONATOR SYSTEM FOR SHAPING ELECTRON BUNCHES OF A NARROW PHASE SPREAD

AFANAS'YEV, V. D., VISHNYAKOV, V. A. and RUDYCHEV, V. G.

/Abstract/ The use of a two-cavity resonator system operating at fundamental and second-harmonic frequencies is considered for the purpose of minimizing the phase spread of electron bunches. The standard deviation of particles from the center of a bunch serves as the characteristic dimension. The two resonators are placed adjacent to one another, and the relative change in phase of the electrons upon passage through the first resonator is assumed small. The high-frequency fields are appropriately phased and the conditions are established under which the bunching parameters become optimum. Figures 2, references 3: 2 Russian, 1 Western.

ESTIMATING THE NOISE IMMUNITY OF A TUNABLE FILTER SUBOPTIMAL IN THE PRESENCE OF CORRELATED NOISE

GOLIKOV, V. S. and SHELOMOV, YE. A.

/Abstract/ A method has been proposed for adjusting, in real time, the pulse response of a tunable filter toward the optimum, for processing of signals mixed with additive correlated noise. This method is based on solving the integral equation of filtration by representing the mirror image of the signal, the autocorrelation function of the noise, and the sought pulse response of the filter in terms of orthnormalized Laguerre

series.  Truncating the infinite series of filter response for practical
design purposes reduces the noise immunity of the system.  According to
the expression derived here for a real filter with a finite-series response,
the maximum useful output signal is numerically equal to the dispersion of
the noise.  References: 2 Russian.

CALCULATION OF THE INDICES OF DISTORTION OF A SIGNAL AT THE OUTPUT OF A
NONSTATIONARY FILTER WITH DOUBLE-TUNED AMPLIFIER

BUKHARIN, S. V. and PEKUROVSKIY, V. V., Voronezhkaya State University imeni
Lenin Komsomal

[Abstract]  In recent years interest in nonstationary filters has increased,
making it possible to improve to a considerable extent the characteristics of
systems, in particular correction of transient distortions of pulse signals.
However, practical use of the results of the theory of nonstationary filters
is limited by the difficulty of achievement of these filters.  Consequently,
the problem of investigating the properties of the simplest nonstationary
filters is timely.  In the present work the indices of distortion at the
output of a nonstationary filter are considered.  The dependences of the
indices of distortion on the correction parameters are analyzed and shown
in the form of curves.  The authors conclude that together with simplicity
of technical achievement, the filter considered assures effective correction
of transient distortions.  The paper is recommended by the Department of
Technical Cybernetics and Automatic Regulation, Voronezhkaya State University.
Figures 2, references:  2 Russian.

CZECHOSLOVAKIA

PROGRAMMABLE FREQUENCY DIVIDERS USING MH 74192 INTEGRATED CIRCUITS

SODR, LUDVIK, engineer, and HLAVAC, STANISLAV

[Abstract]  MH 74192 integrated circuits are manufactured by TESLA at Roznov for use in programmable dividers.  These dividers receive the input signal at levels which are required for TTL circuits.  Activation of the dividers may also take place by a sinusoid signal at a suitable level of intensity; the voltage may be one V.  When this happens the usual operating point of the input circuits must be maintained by some suitable means.  Operation of a programmable frequency divider may be best controlled by means of a counter (for inst. a BM 465 type) functioning as a meter for the frequency ratios. The counter and the output from the programmable divider must be separated by a device preventing a lowering of the limiting frequency by the capacity of the cable connecting the center.  Circuits of the MH 74S type may replace the MH 74192 circuits.  Using the method of two module prescaling or of pulse swallowing, the limiting frequencies may reach the values of 80 MHz. Figures 10, tables 2, references 6:   5 Czech, 1 Western.

EAST GERMANY

NEW MONOLITHIC 10.6 MHz PIEZOFILTER

LAMPE, L., diploma engineer

[Abstract]  An improved further development of the four-circle piezofilter SPF 10 700-A150, the new type SPF 10 700-A190, is described by reference to diagrams of its connections for measurements, of its selectivity curve and of the measuring circuit.  The aging of the piezofilter per logarithmic decade is shown to be +0.2 percent of the middle of the band frequency $f_M$. At the age of 100 days these filters possess their nominal frequency and within the next three years, the center frequency increases at most by +22 kHz. The hitherto existing center frequency block sorting with 100 kHz group width has been reduced to 60 kHz, as shown on the tabulated new groups.  The SPF 10 700-A190 piezofilter represents a structural element which by its small dimensions and its optimum electrical characteristics makes it possible to develop high quality intermediate frequency amplifiers particularly in connection with integrated circuits.  This report is from the Combine State Enterprise Ceramic Works Hermsdorf.  Figures 5, tables 1, references: 2 German.

EAST GERMANY

MECHANICAL FREQUENCY SELECTION.  STAGE OF DEVELOPMENT AND PERSPECTIVES

HAELSIG, C., Chamber of Technology, Kleinmachnow

/Abstract/ Mechanical frequency selection with particular application to
mechanical filters is analyzed on the basis of the fundamental changes in
equipment systems for information transmission in the last two decades, and
relative to the reviews shown of mechanical frequency selection possibil-
ities and optimum frequency domains.  The fundamental principles and reali-
zations, the performance and the stage and perspective of development of
metal-resonator-filters, of monolithic and of surface-wave filters are dis-
cussed with reference to schemes.  The extensive assortment of types from
the Combine of the State Enterprise Elektronishche Bauelement /Electronic
Structural Elements/, Teltow, and the examples of application in radio- and
carrier-frequency engineering illustrate the high importance of these
products for the apparatus and equipment systems of communication trans-
mission.  With respect to the production of surface-wave filter structural
elements it is still early; monolithic filters will probably undergo a
continuous development up to 1985.  This report is from the Combine of the
State Enterprise Elektronische Bauelement, Teltow.  Figures 9. Tables 3,
references 34: 17 German, 17 Western.

CALCULATION OF THE LIMITATION THRESHOLD OF A MEDIUM-POWER AND LOW-POWER MICROWAVE LIMITER

TEKSHEV, V. B.

[Abstract]  The feasibility of effective operation of a microwave limiter on a certain power level is evaluated by using the limitation threshold defined as the incident power at which transmission losses increase by 3 dB compared with transit losses (characterizing the power losses in the linear mode of limiter operation).  A technique is proposed for calculating the value of this index that avoids computing the limiting characteristic of the device. An optimized (two-resonance) limiter is considered, and examples are given illustrating calculation of the limitation threshold for given frequency and diode parameters, and synthesis of a microwave power limiter when the limitation threshold is known (determination of the peak current for the diode). It is found that the limitation threshold is most dependent on the low-power diode loss impedance and fading losses.  Figures 1, references:  6 Russian.

PHASE MODULATOR ON A PIEZOELECTRIC DELAY LINE

BONDARENKO, V. S., REDKOBORODYY, YU. P., IVANOV, P. G., KONYUKHOV, B. A. and SOBOLEV, B. V.

[Abstract]  The authors give the results of an experimental investigation of the modulation of acoustical waves with low-frequency elastic fields which demonstrate the possibility of obtaining deep phase modulation of surface waves in a piezoceramic media.  They discuss questions of designing phase modulators on the basis of the examined effect.  In order to design practical apparatus they find that it is necessary to solve a number of structural and technical problems.  A promising base is the utilization of the effect of localizing the energy of thickness modes in the subelectrode region of the resonator.  This permits connecting the acoustic line at the ends without decreasing the quality of the piezoresonator.  By increasing the frequency of the carrier in conjunction with the use of high-quality materials the suthors are able to design phase modulators in an integral configuration. Figures 3, references 6:  5 Russian, 1 Western.

DISPERSION AND COUPLING IMPEDANCE IN A PERIODIC MULTISTAGE SYSTEM OF COUPLED
LINES

DASHENKOV, V. M.

[Abstract]  Periodically structured delay-line films on dielectric substrates
have contributed to the miniaturization of microwave systems.  The dispersion
and the coupling impedance of such structures are calculated on the basis of
Floquet's telegraph equations in matrix form and their solution in terms of
normal waves and symmetrical components.  Particular solutions are obtained for
one-dimensionally periodic structures of:  first a single-stage infinitely long
line, then a single-stage ladder line, and finally a multistage line with
reactive loads.  Figures 1; references 9: 6 Russian; 3 Western (two in trans-
lation).

OPTIMUM STRUCTURE OF STEP-BY-STEP DISCRETE DELAY LINE

SMIRNOV, N. I. and ZALICHEV, N. N., Moscow Electrical Engineering Institute
of Communications

/Abstract/  Devices constructed on the basis of discrete elements have
recently found more and more use.  Discretization of equipment can also be
used during design of units for optimum processing of a received signal,
constructed on the basis of a step-by-step delay line (SDL).  In so doing
it is necessary to find a structure for the SDL which has a minimum quantity
of delay elements, because their number can amount to several thousands.
The necessity for minimization of the number of delay elements is caused by
the always increasing requirements on the reliability, size and cost of the
devices.  Known SDL with a minimum quantity of delay elements are constructed
on a basis of analog elements.  The present paper considers optimization of
discrete SDL.  The authors conclude that the scheme of the delay line
described, which is based on discrete elements, makes it possible to reduce
considerably the necessary quantity of delay elements, which leads to an
increase of reliability and a reduction of the dimensions and costs of the
device.  This paper is recommended by the Department of Designing of Radio
Electronic Apparatus, Moscow Electrical Engineering Institute of Communica-
tions.  Figures 1, references: 5 Russian, 1 Western (translated).

USSR

TO THE PROBLEM OF CALCULATION OF AN ELECTRICAL FIELD AT THE EDGE OF A
PARALLEL-PLATE CAPACITOR WITH A COMBINED DIELECTRIC

KONOTOP, V. V., candidate in technical sciences, RUDAKOV, V. V., engineer,
Khar'kov Polytechnical Institute imeni V. I. Lenin

/Abstract/ Efficient designing of the insulation of electrical apparatus
and an explanation of the process of aging of a dielectric is impossible
without knowledge of the electric field in the dielectric. The object of
the present paper is the numerical determination of the electrical field
in the immediate proximity of the edge of a plate for construction of a
capacitor type with a combined dielectric, and in connection with this a
solution of the problem of the possibility of use for a similar type of cal-
culation of the equivalent circuits of a dielectric. With the use of the
method of secondary sources, an analysis is made of the field in a system of
capacitor plates, and the voltage distribution at the boundary of the
dielectrics is obtained, An expression is obtained for determining the
field intensity in the immediate proximity of the edge, of an electrode
occurring at the boundary of the dielectrics. It is demonstrated that
during determination of the potential distribution at the edge of a capaci-
tor plate with the aid of an equivalent circuit of the dielectric, an error
is admitted into the assumed quality of the longitudinal capacitances.
Figures 2, tables 1, references: 1 Russian.

CALCULATION OF MAGNETIC CIRCUIT IN DISPLACEMENT-PHASE CONVERTER

ZARIPOV, M. F., URAKSEYEV, M. A., and TURABOV, O., Ufimskiy Aviation
Institute

/Abstract/. Converters of displacement into phase are widely used in systems
for control of technological processes.  A shortcoming of known devices is
the presence of rubbing contacts or mechanical elements in the form of cams
/kulachok/.  Displacement-phase converters with distributed electromagnetic
parameters developed in recent years are more reliable and precise in opera-
tion.  During their design, with the object of selecting optimum dimensions
of the magnetic circuit and optimum operating conditions, it is necessary to
conduct an investigation of the magnetic circuit.  However, information is
lacking in the literature concerning calculation of magnetic circuits with
functionally distributed magnetic conductivity of the air gap.  In the
present paper this problem is solved, using as an example a converter with
a moving screen.  It consists of two symmetrically arranged /-shaped
magnetic circuits, one of the cores of which is enveloped by the moving
screen, and in their bases are placed two identical series and opposing-
connected field windings fed by alternating current.  In the gaps between
the magnetic circuits Hall elements can be arranged.  Analytical expressions
are obtained for the fluxes in the parallel cores of the magnetic circuit,
and the magnetic stress between them.  A method of calculating the magnetic
circuit of a "displacement-phase converter" is explained.  This paper is
recommended by the Department of Information Measuring Technics, Ufimskiy
Aviation Institute.  Figures 3, references: 7 Russian.

HUNGARY

INTEGRATED DIGITAL-ANALOG CONVERTER WITH A DIODE

DALNOKY, GABOR, Industrial Research Institute for Communication Technology

[Abstract]  Digital-analog converters contain a semiconductor element as required by the number of bits, a high-precision resistance circuit and a temperature-controlled reference voltage.  A new circuit in which the currents arranged according to powers of 2 are connected directly though diodes was developed.  Integration in thin or thick layers ensures identical resistance and temperatures of the diodes; as a result, the operating times are kept within the nanosecond range and the circuit has a very low resistivity. A binary 10-bit and a 4-bit version of the circuit have been prepared.  The former was designed as a thick layer with a built-in reference voltage source on a ceramic support.  The analog output voltage of the static, integral-type converter is negative.  The binary 4-bit converter is based on similar principles:  a thin-layer Cr-Ni technology with dual-in-line leads is used. Detailed electric characteristics and circuit diagrams are presented.  Figures 4.

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CONVERTER OF TEMPERATURE INTO A PULSE-DURATION SIGNAL

FESENKO, A. I. and USHAKOV, A. A., Tambovskiy Institute of Chemical Machine
Building

[Abstract]  As shown in the literature, the principal requirements on devices
for conversion and transmission of data concerned with temperature are the
stability and linearity of static characteristics.  The device described in
this paper has an increased linearity of the static characteristics and a
comparatively large dynamic range of operation.  A semiconductor thermal
resistor is used as a primary measuring converter.  The experimentally obtained
static characteristic of the device during operation with a 6.8 kOhm MMT-4
thermal resistor is presented.  The paper was recommended by the Department
of Automatization of Chemical Production, Tambovskiy Institute of Chemical
Machine Building.

USSR                          UDC [621.314.572:621.382.233.026].015.1.001.24

OUTPUT VOLTAGE OF THYRISTORIZED INVERTER WITH NATURAL SWITCHING

BULATOV, O. G., candidate of technical sciences, KURUSHIN, V. D. and
OLESHCHUK, V. I., engineers

[Abstract]  An analysis is made of the operation of an inverter with natural
switching of rectifiers into a load of inductive nature.  The possibilities
are described of control of the output voltage of the inverter by internal
means.  It is found that functioning of thyristorized inverters without
forcing blocking units in the direction of the load, fulfilled by a transformer
with a tapped secondary winding and forming a multistep voltage, adjustable
with respect to magnitude, for a load of inductive nature is combined with
the appearance in the voltage curve of overshoots of reverse polarity which
impair the harmonic composition of the output voltage.  Control of output
voltage with respect to the primary side with the algorithm of forming con-
sidered in the work proves to be more preferable than control with respect
to the secondary side, because in this case the amplitude of the first
harmonic changes according to a linear law, and the percentage of higher
harmonics increases to a smaller degree.  Figures 3, tables 3, references:
3 Russian.

JOSEPHSON POINT DETECTOR IN THE 8-MM BAND

KORCHUGANOV, V. P., LYUBIMOVA, T. F., MURMINOVA, T. M. and ETKIN, V. S.

[Abstract]  The authors give the results of an experimental investigation of
an 8-mm wavelength band detector in a standard waveguide on Josephson super-
conducting point contacts.  This still causes certain difficulties, but the
theoretical value of sensitivity, if noises of the second cascade of the
radiometer are ignored, is equal to 0.0024° which is one order of magnitude
better than the experimentally obtained value.  They find that by improving
the circuits and takeoff of the contacts it is possible to make further im-
provement in the sensitivity of the wide-band radiometers.  Figures 3,
references 4:  2 Russian, 2 Western.

DIFFRACTION OF A CONVENTIONAL CYLINDRICAL LIGHT BEAM BY A WIDE-BAND ULTRASONIC
SIGNAL

MARTYNOV, A. M.

[Abstract]  On the basis of solving a wave equation by the method of small
perturbations the author derives the Parygin-Chirkov integral operator which
describes the diffraction of a conventional luminous flux by a conventional
ultrasonic beam, but with allowance of the heterogeneous waves in the thickness
of the ultrasonic column.  The author formulates the diagram method of solving
the diffraction problem which substantially reduces the intermediate operations
and gives a clear physical pattern of the shaping of the spectra during multiple
scattering.  He demonstrates that the solution to the wave equation with zero
initial conditions for the spectra is obtained from a precise solution to the
problem through the Green function, if the heterogeneous waves are ignored.
He mentions that with a change in the mode of diffraction the spectrum of the
acoustical signal in the first order of diffraction is reproduced with a change
in scale such that in the limiting Bragg mode this scale is half that in the
mode of Raman-Nath diffraction.  He gives recommendations for the algorithm
used to compute the amplitudes of the spectra with allowance for the higher
orders of the theory of small perturbations.  The author expresses his
appreciation to Yu. A. Kravtsov for valuable systematic council and consulta-
tion in the investigation process, and S. M. Rytov for interest and attention
to the work and stimulating conversation.  Figures 4; references 8:  5 Russian,
3 Western.

ONSET OF A CYLINDRICAL WAVE UPON REFLECTION OF A PLANE WAVE FROM A PARABOLIC
CYLINDER

TARASOV, V. N.

[Abstract]  The author is concerned with the two-dimensional problem of dif-
fraction of a plane wave on an ideally reflecting parabola; in this problem
he obtains the short-wave asymptotics of a reflective wave which are uniform
relative to the focal distance of the parabola.  When the focal distance tends

to zero the boundary parabola degenerates into a half line. Using this problem as an example the author traces the continuous transition from describing the diffraction on a smooth body to describing the diffraction on a body with a point. The author thanks V. S. Buldyrev, under whose direction this work was written. References: 5 Russian.

THEORY OF LONGITUDINAL INSTABILITY OF AN ELECTRON BEAM IN A WAVEGUIDE
WITH A MAGNETICALLY ACTIVE DIELECTRIC

NASONOV, N. N. and SHENDEROVICH, A. M.

/Abstract/ The instability of an electron beam is first analyzed in an unsaturated ferrodielectric medium, a ferritic waveguide with finite transverse dimensions, taking into account the Coulomb fields of the beam as well as the dispersion of the magnetic permeability of the ferrite material upon magnetization reversals. The instability mode of the electron beam is found here to depend largely on the magnetization of the ferrite. In the case of a gyrotropic medium, a waveguide with longitudinally magnetized ferrite rings, a higher intensity of the longitudinal magnetic field results in a higher frequency of excited oscillations, according to the half-power law. A buildup of instability causes a redistribution of energy along the electron beam, which renders ferritic waveguides suitable for self-acceleration of intensive electron beams. References 8: 7 Russian, 1 Western.

DIFFRACTION OF ELECTROMAGNETIC WAVES AT A WEDGE WITH A MULTILAYER ABSORBENT
COATING

VASIL'YEV, YE. N. and SOLODUKHOV, V. V., Moscow Power Engineering Institute

/Abstract/ A system of Fredholm integral equations with respect to electric current densities and magnetic flux densities, in cylindrical coordinates, is applied to the diffraction at a wedge of a plane electromagnetic wave with only one magnetic field component (parallel to the edge). With appropriate substitutions, this problem is then solved in the case of a wedge with

a multilayer absorbent dielectric coating. The wedge surface under the coating is either metallized or also dielectric. An analysis of scatter effects in terms of this exact solution and in terms of the optical-physics approximation indicates that, while the latter adequately describes the relation between the amplitude of the reflected field and the thickness of the dielectric coating in the case of thick layers, its error becomes large in the case of one or more layers with a small electrical thickness. Interference effects caused by several factors must then be taken into account. Figures 4, references 12: 10 Russian, 2 Western.

RADIATION FROM AN ELECTRON BEAM MOVING ABOVE AN ARRAY OF CYLINDERS WITH LONGITUDINAL SLOTS

VELIYEV, E. I., NOSICH, A. I., and SHESTOPALOV, V. P., Institute of Radiophysics and Electronics, Academy of Sciences, Ukrainian SSR                    ,

/Abstract/ Radiation from a plane electron beam moving above a periodic array of lengthwise slotted parallel cylinders is analyzed, assuming the cylinder walls to be infinitesimally thin ideal conductors. The problem is reduced to a system of Fredholm linear algebraic equations of the second kind. This infinite system of equations is then solved in the zeroth approximation, whereupon the special case of narrow cylindrical strips and that of sparse cylinders with narrow slots are considered. The results of a numerical solution are discussed, of particular interest being the condition where the energy of diffraction radiation is all contained in one harmonic mode which, without decaying, propagates normally to the array. Figures 6, references 10: 9 Russian, 1 Western.

WAVE PROPAGATION THROUGH A RECTANGULAR WAVEGUIDE WITH A THIN FERRITE FILM

KURUSHIN, YE. P. and CHASOVNIKOVA, T. A., Kuybyshev Electrotechnical Institute of Communication

/Abstract/ A rectangular waveguide is considered with a thin mono- or polycrystalline ferrite film on one of the walls. The propagation constants for

LE$_{mn}$ and LM$_{mn}$ waves in such a waveguide are calculated, with the magnetization of the ferrite film either normal or tangential. The effect of such a film is taken into account by generalized impedance constraints of the anisotropic kind, stipulated in terms of the input-impedance tensor. As a result, relations are obtained which indicate how these propagation constants depend on the external field, its intensity and direction, as well as on the frequency and on the saturation magnetization of the film material. Figures 5, references 11: 10 Russian, 1 Western.

ROLE OF FORESHORTENED SCATTERING AT AURORAL INHOMOGENEITIES IN THE SLIP MECHANISM OF RADIOWAVE PROPAGATION

MATYUGIN, S. N. and URYADOV, V. P., Scientific-Research Institute of Radio-physics

/Abstract/ The effect of foreshortened radiowave scattering at geomagnetically oriented auroral inhomogeneities in the ionosphere on the extraction of energy from the ionospheric wave channel, through reception of return signals, has been established on the basis of computed intersections between the earth's surface and the cone of mirror-reflection scattering. Such an extraction was found generally possible at all test points in the Indian and Atlantic Oceans. However, foreshortened scattering is most intensive at auroral and subauroral latitudes. The angular dimensions of these intersection curves are much smaller at the equator than within the Antarctic region, moreover, so that the probability of receiving return signals decreases as the equator is approached. Experimental data are compared with the theoretically estimated efficiency of return signals reception. Figures 1, references 11: 9 Russian, 2 Western.

HUNGARY

DIFFRACTION OF ELECTROMAGNETIC WAVES

CSERNOCH, JANOS, graduate physicist, scientific and technical consultant, Main Microwave Department, Orion Radio and Electrical Enterprise

/Abstract/ The author discusses the physical fundamentals of diffraction and various radiation-theoretical problems such as the scalar Huyghens principle in an internal point of the closed space section, the scalar Huyghens principle in an external point of the closed space section, and general guidelines for microwave transmission paths (determination of the curvature resulting from the curvature of the earth, examination of the purity of the first Fresnel ellipsoid, and drawing the terrain sections). After having explained the scalar Huyghens principle, the author describes some of its applications and, introducing the concept of complex field strength, presents a novel approach for calculating the diffraction. It enables the designer to work simultaneously with electrical and magnetic field strength, and to eliminate the use of the Hertz vector and the vector potential to simplify the calculations. Figures 11, references 9: 3 Czechoslovak, 2 Hungarian, 4 Western.

PROPAGATION OF RADIOWAVES IN A WEAKLY HETEROGENEOUS STRATIFIED ATMOSPHERE

GRIKUROV, V. E.

[Abstract]  The author solves the problem of tropospheric propagation of
radiowaves over the Earth's surface by the method of normal waves generalized
to the case of the refractive index as a function of two coordinates--altitude
above the Earth's surface and distance along the line of sight.  The author
assumes that the dependence on distance along the line of sight is a weak one.
He obtains formulas which are applicable all the way up to distances at which
the refractive index at a fixed altitude varies by approximately e times.
References 8:  7 Russian, 1 Western.

DETERMINATION OF THE ALTITUDINAL TEMPERATURE PROFILE FROM RADIOMETRIC
GROUND MEASUREMENTS OF ATMOSPHERIC RADIATION

ALESHIN, V. I., NAUMOV, A. P., PLECHKOV, V. M., SUMIN, M. I., and
TROITSKIY, A. V., Scientific-Research Institute of Radiophysics

/Abstract/  Determination of the altitudinal temperature profile from
angular measurements of atmospheric radiation involves mathematical problems
such as estimating the optimum probing frequencies and angles, for which the
method of statistical regularization is used here, and physical problems such
as the variations in the brightness temperatures.  The significance of radio-
metric ground measurements must be considered in view of the possible effect
on the results of the meteorological parameters of the ground layer.  Such
measurements of atmospheric radiation within the $\lambda \sim 5$ mm band were made in
spring, summer, and winter at 50-52 and 53.4 GHz.  The data are evaluated
here in terms of both accuracy and reliability.  The authors thank M. B.
Zinichev and I. R. Fomin for part of the calculations fulfilled on the BESM-
4 electronic computer, as well as A. N. Ivannikov and K. P. Gaykovich for
participation in processing of the data.  Figures 9, tables 2, references
36: 21 Russian, 15 Western.

FLUCTUATIONS IN THE INTERFERENCE PATTERN DURING PROPAGATION IN THE ATMOSPHERE

LUKIN, I. P. and MIRONOV, V. L.

/Abstract/ The authors are concerned with the statistical characteristics of fluctuations in the field intensity in the interference pattern formed by two mutually coherent spaced point sources, the radiation from which passes through a layer of turbulent atmosphere. Because the average interference pattern is disturbed by the atmosphere, the authors examine the possibility of detecting the spatial structure of the intensity, using correlation analysis. They find that knowledge of the signal received is necessary to measure the fluctuations in intensity of the interference pattern so as to be able to select the parameters of the registering apparatus. They further study the question of the accuracy of determining the speed of the receiver moving across the interference pattern. Figures 3, references: 4 Russian.

CALCULATING THE FIELD OF RADIO WAVES ABOVE AN UNEVEN GROUND

CHERNYY, F. B., BAKHVALOV, B. N. and ZHUKOV, S. A.

/Abstract/ The earth's radio interference factor is determined for the case where surface asperities are smooth but their height may be large relative to the wavelength. The radiator, an elementary Hertz dipole, is located at an altitude h above the ground in either a horizontal or vertical position. With this arrangement, the field intensity is calculated at distances R and altitudes z ($R \geqslant z \geqslant h$), the latter far above the surface asperities. The ground is regarded as real, not ideally conducting, and homogeneous. The solution is sought in the Kirchhoff (tangent plane) approximation and is derived from the integral equation for the Hertz vector, considering that the reflection coefficient in the far-field zone may be assumed equal to -1 and then integrating over the near-field zone accordingly. The formula for the earth's interference factor obtained by this method has been verified experimentally, by the astronomical method with the sun's radiation. The results are found in close agreement, some discrepancies being attributable to the presence of various objects near the test antenna. Figures 2, references: 3 Russian.

FREQUENCY SPECTRUM OF PHASE FLUCTUATIONS IN A COLLIMATED LASER BEAM
PROPAGATING THROUGH A TURBULENT ATMOSPHERE

MILYUSHIN, YE. R. and SAVITSKAYA, V. B.

/Abstract/ The frequency spectrum of phase fluctuations in a collimated
laser beam is calculated, on the basis of the smooth-perturbations approx-
imation and the Kolmogorov model of atmospheric turbulence with the appro-
priate spectral density of dielectric permittivity. This spectrum is
found narrower than in the case of a plane wave, which agrees with con-
clusions based on the Karman model of turbulence. Figures 1, references 6:
4 Russian, 2 Western.

DIFFUSE SPREADING OF IONOSPHERIC NONUNIFORMITIES IN A MAGNETIC FIELD

FILIPP, N. D., Bel'tsy State Pedagogical Institute

/Abstract/ At temperate latitudes strongly anisotropic nonuniformities
in the electron concentration of the ionosphere have been discovered which
are oriented in the direction of the earth's magnetic field. A study was
made concerning the decay of these nonuniformities. The differential dis-
tribution of radio spikes, with respect to their duration, was measured
over a 1330-km long route between two points approximately at the $46^{\circ}$
latitude, where the $H_E$-scattering zone and the active zone of meteoritic
reflections partly overlap. The experimental results confirm that at
altitudes above 95 km the diffusion of such magnetically oriented nonuni-
formities becomes electron-controlled and their decay slows down appreciably.
Figures 3, tables 2, references 7: 3 Russian, 4 Western.

OPTICAL LOCATION OF MICROPHYSICAL CHARACTERISTICS OF SCATTERING MEDIA

KREKOV, G. M., KREKOVA, M. M., MAKIYENKO, E. V. and NAATS, I. E., Institute of Atmospheric Optics, Siberian Affiliate, Academy of Sciences, USSR

/Abstract/ One of the most important tasks of remote laser sounding of natural scattering media is that of determining the parameters of the microstructure and the physical characteristics of atmospheric aerosol formations. This report analyzes a method of reproduction of the microphysical parameters of clouds on the basis of data from an optical location at several frequencies. As the cloud aerosol is probed, the solution of the reverse problem in most cases can be produced in its simplest form, because it is possible to assume the analytic form of distribution of particles by dimensions to be known a priori, because it generally corresponds to the gamma distribution, and further to assume the index of refraction known. In this case, the reverse problem can be solved by the method of optimal parametrization, based on approximation of the optical characteristic measured at several wavelengths by a certain model value, determined by the form of distribution of particles by dimensions and by its parameters. The influence of systematic and random measurement errors, the background of multiple scattering, as well as the a priori selection of parameters on the accuracy of reproduction of the concentration of moisture and the microstructure of the scattering particles are analyzed. Figures 4, tables 2, references 11: 10 Russian, 1 Western.

DIFFRACTION OF ULTRASHORT WAVES AROUND THE EARTH IN THE BILINEAR MODEL OF THE TROPOSPHERE

ANDRIANOV, V. A., Institute of Radio Engineering and Electronics, USSR Academy of Sciences

/Abstract/ With the troposphere model with a bilinear profile of the refractive index, the problem of propagation of ultrashort waves is solved here by representing the field of radio waves as a sum of the diffraction field around a smooth spherical surface and, within the shadow zone, the field of successively diffracting waves reflected at the edge within this bilinear model. The field attenuation function is first derived in terms of the

scalar problem, and then the diffraction field of m-times reflected waves is calculated by the method of residues. The resulting asymptotic expressions are simply constructed and easy to use. The results of this analysis may be helpful in further studies concerning the role of scattering of ultrashort radio waves in a layerwise nonhomogenous troposphere. The author thanks L. A. Vaynshteyn for attention to the work and helpful critical remarks. Figures 4, references 11: 5 Russian, 6 Western.

EFFECT OF MULTIMODALITY OF THE EARTH-IONOSPHERE WAVEGUIDE CHANNEL ON THE CORRELATION CHARACTERISTICS OF VLF SIGNALS

BEZRODNYY, V. G. and SHUBOVA, R. S., Institute of Radiophysics and Electronics, Academy of Sciences, Ukrainian SSR

/Abstract/ As a result of multimodality of the earth-ionosphere waveguide channel within the VLF (10-30 kHz) range, the field distribution over distances is governed by interference which, in turn, affects all statistical characteristics of a signal. This includes the sign of various correlation factors. The latter are calculated here and analyzed for the simplest two-mode model of that channel, with both amplitude and phase variations of the resultant field, thus each becoming a function of only the fluctuations of the amplitude ratio and the phase difference between the two modes. A mathematical analysis reveals that, as the distance from the transmitter increases, the amplitude-phase cross-correlation factor not only decreases but also reverses sign repeatedly. The spatial and interfrequency phase-phase and amplitude-amplitude correlation factors also reverse sign with increasing spread. Different measurements at the same distances and frequencies may also yield correlation factors with different signs, because of changes in the mean waveguide parameter values from one measurement to another. Figures 3, references: 3 Russian.

SIMULTANEOUS MEASUREMENT OF THE ANGULAR COORDINATES AND THE RANGE FROM A
PHASE FRONT

BAKUT, P. A., LOGINOV, V. A., MANDROSOV, V. I. and TROITSKIY, I. N.

/Abstract/ Digital holography makes it feasible to extract the phase
front and, with the information encoded therein, to synthesize optimal
algorithms of measurement.  Here this principle is applied to a simultan-
eous determination of the angular coordinates and the range of a coherent
source within the Fresnel zone.  A mathematical analysis based on the
assumption of a point source and a one-dimensional aperture indicates that
a rather simple optimal algorithm can be constructed for estimating the
direction and the distance of such a source under conditions of atmospheric
distortions.  References: 1 Russian.

MEASUREMENT OF THE SPECTRUM OF FLUCTUATIONS OF LASERS OF THE COMPLEX OF
STATE SPECIAL STANDARDS FOR COHERENT EMISSION

ALENTSEV, B. M., BAGIMOV, A. I., GROMOV, YU. N., YELAGIN, A. YU. and
LEVCHENKO, D. G.

/Abstract/ Measurements of the spectrum of fluctuations of the emissive
power of lasers in a wide-frequency band is of importance for study of
physical processes in lasers during their use in communication systems or
in measuring devices, as well as in other fields.  These investigations
acquire particular value during the use of lasers in the composition of
the special standards of units of coherent emission: pulse power, spectral
density of noise power, and relative density distribution of power.  The
present paper presents the results of measurements of the spectra of fluc-
tuations of the emissive power of lasers with lengths of the generation
waves of 10.6, 3.39, and 0.63 micron, especially worked out for use in the
standards mentioned.  Measurements of the spectra were made in the 0.5 Hz--
5 MHz frequency range with the aid of equipment, a block diagram of which
is briefly discussed.  In the frequency range 0.5 Hz--0.5 MHz the overall
error of this equipment did not exceed 0.05 from the valve of the spectral
density of the emission fluctuations.  For the lasers investigated, this
error did not exceed $5 \cdot 10^{-4}$ in the frequency range 0.5 Hz--1 kHz, and $10^{-5}$

in the frequency range 1 kHz--0.5 MHz, from the level of the mean emissive power. The principal compound errors of reproduction of a unit of duration of optical emission are stated. Figures 2.

ANIKEYEVA, N. V., BATYGINA, A. I., YEGOROVA, T. K., KOLESOV, G. V., NOVIKOV, V. G., SLESAREV, M. V., STEPANOV, B. M., USACHEV, B. F., and KHLESKOVA, T. N.

/Abstract/ One of the important characteristics of pulsed lasers is the duration of an optical emission pulse. At present, industry manufactures a small-sized series of instruments, which are listed in table form, that can be used as the operational means for measurements of the duration of laser emission pulses, and a number of instruments are under development. However, for the present, apparatus with the aid of which the duration of an optical emission pulse is determined cannot be considered measuring apparatus because precision characteristics are not set in its norm-technical documentation, and methods and periods of checking are not determined. A system of metrological assurance of measuring the duration of an optical emission pulse of a laser, which includes standards, a checking unit, standard means of measurement, and other components is practically nonexistent. The results are presented of the development and investigation of the metrological characteristics of a checking unit of superior precision, intended for checking standard and operating means of measuring the duration of individual optical emission pulses in the $5 \cdot 10^{-10}$--$5 \cdot 10^{-9}$ second range in the first channel and $10^{-7}$--$10^{-6}$ second in the second channel. Both channels of the unit can operate independently. Figures 3, tables 1, references 9: 6 Russian, 3 Western.

AUTOMATIC MEASURER OF DENSITY OF DISTRIBUTION OF ENERGY IN CROSS SECTION
OF THE EMISSION FLOW OF A PULSED LASER

ZAGORSKIY, YA. T., KOZACHENKO, M. L. and KUZNETSOV, A. A.

/Abstract/ The problem of investigating the energy distribution in a cross
section of the emission flow of lasers can be solved by the use of a multi-
element system of primary measuring transducers of calorimetric, pyroelectric,
and other types. The construction is described of a highly-sensitive calor-
ometric measurer of the density distribution of energy, with a broad dynamic
range and a comparatively high precision of measurement, which is based on
a union of the necessary number of channels operating in parallel, and
having in its structure a mosaic 100-element primary measuring transducer
(PMT), a secondary measuring transducer (SMT) with a large amplification
factor, memory devices, a commutator, analog-digital transducer and record-
ing. The PMT is a thermoelectric transducer with a graphite receiving
element and Chromel-Copel thermocouples, connected to a thermopile. The
conversion ratio of the PMT amounts to 500-700 microvolt/Joule, the output
resistance is approximately 5 ohm, the time of attainment of the maximum
value of the signal after the action of the laser pulse amounts to 4.5 ±
0.5 sec, and the time of conservation of the maximum value of a signal is
approximately 1 sec (at a level 0.99 from the maximum value). The SMT is
made of two 1UT401B integrated microcircuits. The recording time of the
signals in all 100 circuits amounts to approximately 1 minute. The error
of measurement does not exceed 15 percent. The measurer was developed at
the VNIIOFI (expansion unknown) and at present is manufactured by the Moscow
Experimental Plant "Etalon" /Standard/ as the IRE-100 measurer of energy
distribution. Figures 2.

HUNGARY

OPTIMUM NOISE MATCHING OF HEAT SENSORS

AMBROZY, ANDRAS, dr, Department of Electrical Engineering, Budapest
Technical University

/Abstract/ Noise ultimately determines the limit of the ability to measure
small temperature differences with electrical heat sensors such as sensors
based on resistance change (metal, single-crystal intrinsic, granular
resistors such as a thermistor or doped barium-strontium titanate), of the
thermocouple type, and p-n transistor-based sensors prestressed in the
opening direction.  The types of noise encountered are thermal noise, back-
ground noise, shot noise, generation-recombination noise, and pulse noise.
The various heat sensors react differently to the various noise types.
These reactions are discussed with the aim of establishing the optimum
methods for matching the sensors for specific uses.  The method of matching
will also depend on whether the sensor has current noise characteristics.
If it does, the best methods use passive bridge circuitry or active pre-
stressing; the latter is preferable if the noise is in proportion to the
current level.  An appendix describes an equation for calculating the out-
put impedance of the bridge.  Figures 6, tables 1, references 16: 2
Hungarian, 14 Western.

PARAMETER OPTIMIZATION IN THE SYNTHESIS OF A METER WITH A LIMITED "MEMORY"

KRINITSKIY, R. L., MURAKHIN, A. A., and KUNYANSKIY, V. A.

/Abstract/ The problem of filtering a parameter $\lambda$ from an additive mixture
of signal and noise is treated. The article is devoted to optimizing the
parameters of the smoothing circuits of a radar meter with a limited "memory"
and an order of astatism which assures the measurement of the parameter $\lambda(t)$
and its derivatives $d^{\nu}\lambda/dt^{\nu} = \lambda^{(\nu)}(t)$. The synthesis of the radar meter
is substantially simplified by the assumption that the meter is stable over
a time interval $T$ and that $\lambda(t)$ can be expanded in a Taylor series in
this interval. The synthesis is based on the criterion of a maximum of the
probability that running measurement error does not exceed set limits, and
is broken down into three steps. In the first step, the mean value of the
error in $\lambda$ (the dynamic error) and the mean square value of the fluctuation
error are determined as a function of the size of the "memory". This
relationship is expressed as a pulsed transfer function of the smoothing
circuits with a limited "memory" and a certain amount of astatism. In the
second step, the optimum value of the "memory", $T_{opt}$, of the radar memory,
which minimizes the overall weighted error is determined, and in the third
step, the optimum value of the weighting factor, $Z_{s\ opt}$, is found from the
probability condition cited above. The formulas derived for $T_{opt}$ (the
optimum observation time), $Z_{s\ opt}$, the effective passband and the error
coefficients of an optimum radar meter for the measurement of the parameter
$\lambda$ and its derivative $\lambda^{(\nu)}$, are presented in a table. Tables 1, refer-
ences: 3 Russian.

AN INTERFERENCE METHOD OF DETERMINING THE POSITION OF A STANDING WAVE
NODE IN THE SHORTWAVE BAND

AKHACHINSKIY, A. V., KOSYREY, B. YA. and ZAKHAROVA, M. I.

/Abstract/ A method is described for measuring electrical lengths, which
is based on the interference between the incident and reflected wave at a
voltage node. The use of the interference method for the readout of the
node permits a significant increase in the measurement precision, which is

preserved at small signal levels. Block diagrams show the configuration
of the equipment for measuring the VSWR node. Values between established
and measured quantities are shown in tabular form and indicate a measure-
ment error in the shortwave band of no more than 0.07°. Figures 2,
tables 2, references: 2 Russian.


USSR                                                UDC 621.317.4--52:621.397.12

USE OF AUTOMATIC DIGITAL MEASURING DEVICE ELEMENTS FOR CONSTRUCTION
OF MEASURERS OF THE PARAMETERS OF TV CHANNELS

BUTTA, V. I., and ZHIDACHEVSKIY, A. V.

/Abstract/ In order to assure high-grade television broadcasting, it is
necessary rigidly to maintain at a standard the characteristics of TV
broadcasting equipment. Checking of the quality of the video signal pass-
ing through a channel is performed by the transmission of TV test signals
through it. At present, verification of the parameters of TV channels by
the results of the transmission of test signals and qualitative evaluation
of the amount of distortions is mainly performed with an oscillograph.
However, the oscillographic method of measurement has a number of significant
shortcomings. As a result of these shortcomings, checking of a channel
occupies much time and is characterized by slight precision and low effi-
ciency. It is possible to remove these shortcomings by automation of
measurements. In practice, TV measurements of large volume are occupied
with measurements of relative magnitudes characteristic of the ratio of the
distortion of a signal to its peak-to-peak value (or signal-to-distortion
ratio). On the basis of an analysis of typical distortions of TV test
signals passing through a channel, the authors developed the structure and
principal circuit of an automatic measurer of distortions and constructed
a model, confirmatory of the possibility of using the method described in
the paper for measurement of the parameters of TV channels by certain test
signals. The form of the signals and their typical distortions are shown.
The result of measurement of all signals is expressed by the general for-
mula

$$K_a = \frac{A - a}{A} \cdot 100 \text{ percent} = \frac{\Delta A}{A} \cdot 100 \text{ percent},$$

where $K_a$ is the magnitude of distortion in percentages; A is the peak-to-
peak values of the undistorted part of the signal or the greatest magnitude
of the signal; a is the peak-to-peak values of the distorted part of the
signal or the smallest magnitude of the signal; $\Delta A$ is the magnitude of the
distortion. An analysis of the formula shows that an automatic measurer
must derive from the distorted signal information concerning the magnitudes
of A and a or A and $\Delta A$ in order to present this information in discrete


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or analog firm, automatically to process it, and to issue the result of measurement in discrete form. It is shown that fulfillment of these operations is done best by construction of an automatic digital measuring device (ATsIP). Use of ATsIP elements makes it possible to create multifunctional automatic measurers of the parameters of TV channels. Work with pulse discrete signals makes it possible to use elements and units in microcircuit fulfillment, to increase the reliability and the operational parameters of the apparatus. Figures 4, references: 3 Russian.

SOBTSOV, N. V.

[Abstract]  In this continuation of a study of two-scale phase measuring systems the estimate of the maximum likelihood in such a system is interpreted geometrically in the parametric coordinate plane. On this basis are now calculated the dispersion of the estimate, the error distribution density, and the probability of an anomalous error. In the synthesis of two-scale phase measuring systems, accordingly, the logical aim is to maximize the range of unambiguous readings and to minimize the dispersion of the estimate as well as the probability of an anomalous error. This problem is solved by stipulating the said constraints in the appropriate form and then plotting ellipses, rather than using Lagrange multipliers, if the requirements of integrality and mutual simplicity are taken into consideration. The author thanks L. I. Byalom for helpful discussions, one of the results of which is the present paper. Figures 4, references 6:  5 Russian; 1 Western.

MAGNETOSENSITIVE PRIMARY MEASURING TRANSDUCERS OF CURRENT DENSITY IN ELECTROLYTE

GUSEV, V. G., FOKIN, A. N., FOKIN, N. K., and IVANOV, M. P.

/Abstract/ In many respects the quality of galvanic coatings is determined by the precision of maintenance of the required current density at articles subjected to treatment. As a rule the various known methods are indirect and do not assure the required precision of maintenance of the specified current density. In addition, they hinder operational investigation of the distribution of the current density at articles even of simple configuration. For measurement of current density during fulfillment of galvanic coatings it is advisable to use devices with noncontact magnetosensitive primary measuring transducers, which make it possible to perform measurements in a bath, directly on the articles subjected to galvanic treatment. The present work is concerned with the construction of such a device. Experimental investigations were made of primary measuring transducers, fulfilled according to both a magnetic amplifier circuit and the circuit of a magnetizing choke with a correcting amplifier. Two models on the basis of a magnetic amplifier were produced of devices for control of the current density in an electrolyte with measuring transducers, and one model on the basis of a magnetizing choke. Small-size cores of 79NM Permalloy were used in the primary measuring transducers. The devices were fulfilled with a limit of measurements of $10^{-2}$ A/M$^2$. A further increase of sensitivity is connected with the necessity for improvement of the characteristics of the ferromagnetic cores of the measuring transducers. The error of the devices at a constant temperature of the electrolyte amounted to 1 percent. During a change of the temperature within the limits +10...+90°C a temperature error of 4 percent was observed, caused by a shift of the zero of the device, which is a consequence of the temperature instability of the material of the magnetic circuit. Tests conducted under laboratory and workshop conditions showed a high efficiency of operation of the primary measuring transducers. Figures 3, references 5: 4 Russian, 1 Japanese ? (translated).

MAGNETORESISTIVE TRANSDUCERS FOR MEASUREMENT OF STRONG MAGNETIC FIELDS

ZVENIGORODSKAYA, A. I., LAVROVA, V. V., LEVITSKAYA, N. V., LUKICHEVA, N. I., and FISHER, L. M.

/Abstract/ The results are presented of experimental investigations of the metrological characteristics of magnetoresistors in 0.5--6.0 T fields in the 4.2--300 K temperature range. The magnetoresistors were developed and produced on a basis of the eutectic alloy InSb-NiSb of an electron type of conductivity, with various concentrations of doping impurities, and non-doped. The investigations were made for the purpose of creating small-size measuring transducers of strong fields with a high sensitivity and stability, small temperature coefficient and transfer functions--with a dependence of the magneto-resistive ratio on a field $\frac{R}{R_o}$ (B) close to linear. All the magneto-resistor specimens investigated have a satisfactorily high reproducibility of characteristics after multiple immersions in helium and a high (in the limits of measurement error) annual stability. Figures 2, tables 2, references: 4 Russian.

HUNGARY                                    UDC 621.317.73:681.3.06

BALANCING ALGORITHMS FOR IMPEDANCE-MEASURING ZERO NETWORKS

DEKANY, LASZLO, Hungarian Cable Works; PATAKY, PETER, Chair of Instrumentation and Measurement Technology, Budapest Technical University

[Abstract]  After a review of the basic problems encountered in manual control, the advantages presented by an algorithm-controlled microcomputer for balancing the measurement circuit of impedance-measuring networks, the fundamental design considerations of these networks and the balancing and feedback circuits are discussed.  The algorithms are based on the measurement of the absolute value or of the phase sensitivity.  Because of possible disturbances and errors, the balancing process must be carried out in an iterative manner.  It is concluded that the best algorithm involves at the start the determination of the absolute value, followed by a method based on an iterative phase detection near the root. The microprocessor-controlled hardware and software of the Glynne bridge, which is used to determine the capacitance loss, is described as an illustration of an impedance-measuring zero network.  Figures 7, references 24:  10 Hungarian, 14 Western.


HUNGARY                        UDC 621.317.73.085.3:511.1:52-503.55:681.3

USE OF MICROCOMPUTER IN PROGRAM-CONTROLLED IMPEDANCE METERS

STEINER, LASZLO and SZENN, OTTO, Chair of Instrumentation and Measurement Technology, Budapest Technical University

/Abstract/ The use of digital impedance meters controlled by a microcomputer is examined to illustrate the application of microprocessors in measurement technology.  After reviewing the correlation and the hierarchical classification of the components of automatic instrumentation systems from the viewpoint of systems engineering, the hardware and software features of these systems are described.  When selecting a specific input/output system, the designer must consider the interface between the chosen microprocessor and the peripherals including problems of systems control, displaying and printing the results and the keyboarding of the instrument.  The program must be able to supply the needed constants to the registers, carry out and control the operations and store the results.  A typical subroutine and frequently used program units are described.  Figures 9, references: 4 Hungarian.

MULTIRANGE QUICK-ACTING AUTOMATIC DIGITAL FREQUENCY METER

KIRIANAKI, N. V., KAZANTSEV, YE. M. and MOSHIYEVICH, P. M. [deceased],
L'vov Polytechnical Institute

[Abstract]  The wide use of digital frequency meters (DFM) in measuring
technics is caused by the ever increasing use of sinusoidal or pulse signals
as the general-purpose output parameter of frequency data units.  The wide
range of change of these signals gives rise to the necessity for using DFM
with automatic selection of the limits of measurement, without loss of the
speed of response and precision.  These requirements are satisfied by the DFM
described in the present paper, fulfilled on a base of Series 133 integrated
microcircuits.  In the 10 Hz--10 MHz range, the DFM measures the mean value
of the frequency in the course of a standard interval of time, which is
automatically selected.  Thus, in the 0.01--10 Hz range it measures the
"instantaneous value" of the frequency for one of its periods, after which
the number $N_T$, obtained in units of the period, transforms into the number
$N_F$, inverse to it, in frequency units.  Such a transform is based on the
use of digital positive feedback.  The errors of transformation are discussed.
As an illustration of fulfillment of the units of a DFM using Series 133 (155)
integrated microcircuits, the basic circuit is worked out of one decade of the
main memory and a decoder.  The synthesis is described of an optimum binary-
decimal decoder.  The paper was recommended by the Department of Automatics
and Telemechanics, L'vov Polytechnical Institute.  Figures 2, tables 2,
references:  3 Russian.

CONCERNING THE NECESSITY FOR PRECISE MEASUREMENT OF THE AMPLITUDE-FREQUENCY
CHARACTERISTICS OF AUDIO-FREQUENCY CHANNELS

LEVENTAL', I. YA. and ODESSKIY, V. YA., Tashkent Electrical Engineering
Institute of Communications

/Abstract/  A method is proposed for evaluating the required precision of
adjustment of the frequency, and reading the overall attenuation during
measurement of the amplitude-frequency characteristics of audio-frequency
channels, on the basis of representation of the results of inaccurate

measurements in the form of signal distortions. The authors conclude that the proposed procedure makes it possible to substantiate the requirements for measurement of the amplitude-frequency characteristics of communication channels and routes. The paper is recommended by the Department of Radio Communication and Radio Engineering Systems, Tashkent Electrical Engineering Institute of Communications. References: 5 Russian.

ACCURACY OF DOPPLER MEASUREMENTS WITHIN THE SHORT-WAVE BAND

BAYUKLINA, M. F. and KRASNOV, V. M.

/Abstract/ The accuracy of Doppler frequency shift measurements is determined by the frequency characteristics of the analyzer as well as by the blurring of the spectral line because of signal passage through the ionosphere. Simultaneous amplitude and phase measurements were made in a tranquil ionosphere with a very stable (of the order of $10^{-9}f$ per h) reference oscillator, of quasi-monochromatic signals at the frequencies of 2.5, 5.0, 10, and 15 MHz being transmitted from Tashkent to Alma-Ata (700 km) and from Moscow to Alma-Ata (3100 km). These measurements indicate that during reflection of short waves at layers E and F, amplitude fluctuations determine the blurring of the base of a spectral line and slow frequency fluctuations determine the blurring of its peak. The accuracy of Doppler measurements can reach the order of 0.01 Hz in the absence of slow frequency fluctuations. The accuracy at resolutions within the 0.01-0.08 Hz range is equally affected by the parameters of the ionosphere and the frequency characteristics of the analyzer, at resolutions poorer than 0.08 Hz, mainly by the bandwidth of the filter. Calculations show that the blurring of a spectral line is wider at higher carrier frequencies. At the same frequency of 10 MHz, wider blurring occurs over the shorter path, probably because of a deeper penetration into the ionosphere and, consequently, a stronger influence of the latter. The authors thank N. F. Nikolayevskiy for assistance during joining of the experimental unit with an electronic digital computer and during formulation of the processing program. Figures 4, tables 1, references 8: 6 Russian, 2 Western.

USSR                                                    UDC 621.317.444

VECTOR MAGNETOMETER

AFANAS'YEV, YU. V., PRISHCHEPO, VIN. A., PORFIROV, V. P., PRISHCHEP, VL.
and GUBANOVA, L. N.

/Abstract/ The circuit and design are described of a magnetometer with a
follow-up system developed at the All-Union Scientific-Research Institute
of Metrology imeni D.I. Mendeleyev, and intended for measurement of the
three orthogonal components of the vector of a variable magnetic field under
conditions of a moving platform. The design of the magnetometer was devel-
oped in two versions. A magnetometer of the first version was installed on
the "Interkosmos-10" satellite launched in the Soviet Union on 30 Oct 1973.
The magnetometer satisfies the following requirements: the limits of measure-
ment with respect to each component of the field is $\pm$ 600 n T. An output
voltage of 6 volts corresponds to maximum values, during which information
concerning the sign of the field is transmitted through a specific channel.
The frequency range is 0.1--10 Hz. The maximum sensitivity ($S_{max}$ = 10 mV/nT)
is assured at a frequency of 0.5 Hz. The speed of processing of the follow-
up system is $10^{\circ}$/sec. The principal error, taking account of the dynamic
errors of the follow-up system (during rotation of the platform in the
magnetic field of the earth with a period $T \geq 2$ min) is not more than 5 per-
cent. A photograph is shown of a special stand, developed for tests, cali-
bration and checking of a magnetometer under conditions close to reality.
Figures 4, references: 5 Russian.

USSR                                            UDC 621.317.729.1:621.317.4

CONCERNING IMPROVEMENT OF THE CHARACTERISTICS OF MEASURING LOOP ANTENNAS

NEDIKOV, N. F., VORONOV, G. M. and KORABEL'SHCHIKOV, G. V.

/Abstract/ At present, nontunable loop antennas are used for measurement
of the intensity H of the magnetic components of electromagnetic fields in
the region of electromagnetic convertibility and radio noise, in the case of
geophysical methods of search and prospecting for minerals. They consist of
one measuring winding with a specific number of loops housed in an electro-
static screen; the principle of operation of these antennas is based on the
law of electromagnetic induction. The operating conditions of such measur-
ing loop antennas create a number of significant shortcomin s. It is
impossible to employ the antennas without a special calibration (determina-
tion of the dependence of the output signal on the intensity and frequency

of the magnetic field) in the measuring process. The measuring loop antenna developed by the authors is calibrated only during the process of manufacture and tuning, has increased sensitivity and an enlarged operating frequency range of measurement, as well as increased noise immunity. The measuring device consists of a loop antenna, the output signal from which proceeds through a matching arrangement to an amplifier-converter. The measuring loop antenna consists of two windings (with equal average diameters of the turns), connected in series, opposing and parallel to which variable resistors are connected. Experimental data confirm the improvement of the characteristics of the newly-developed measuring loop antennas. The working frequency of this antenna is larger than applicable one-winding loop antennas by 1.5--2 times and amounts to 0.1--1 MHz. Figures 4, references: 2 Russian.

ESTIMATING THE ERROR OF SPECTRUM CALCULATION BECAUSE OF THE FINITE SWEEP BAND

GOLUBEV, YU. G. and SEREBRENNIKOV, V. I.

[Abstract]  A receiver is considered where the input signal mixes with the linearly-frequency-modulated signal from the local heterodyne oscillator and then passes through a matched filter. The spectrum of the input signal is calculated approximately by the "stationary phase" method and the error introduced by the finite frequency deviation of that oscillator is estimated by appropriate transformations, with sums replaced by an integral and with the bandwidth of input signals defined in terms of their energy content. A single radio pulse is considered for illustration and, on the basis of computer data, the correlation factor is plotted as a function of the oscillator bandwidth for various values of the parameter characterizing the bandwidth of such a radio pulse. Figures 4; references: 4 Russian.

ALGORITHM FOR EXPERIMENTAL DETERMINATION OF ERRORS OF PHASE METERING
SYSTEMS

KRAVCHENKO, S. A., and CHMYKH, M. K.

/Abstract/ During design of phase metering systems of increased precision,
difficulties arise in experimental determination of errors. Known methods
and apparatus for checking phase meters have errors which exceed the errors
of present-day measurers or are commensurable with them. Two-phase genera-
tors, particularly on the basis of frequency dividers, are widely used for
experimental determination of the errors of phase meters. Such two-phase
generators assure discrete assignment of phase shift (with discrete 360/K,
where K is the coefficient of division of the divider) in the 1--10 MHz
range. Methods of heterodyning make it possible to expand the range of two-
phase generators on the basis of dividers to 100-1000 MHz. Practice shows
that errors of present-day phase meters, e.g., digital and two-phase gener-
ators on the basis of frequency dividers, are commensurable and are found
at the level $(0.1--0.01)^\circ$. Known methods of checking do not make it pos-
sible to perform an experimental determination of their error with such
precision. Consequently, the necessity arises for development of a
procedure which makes it possible to determine the error of phase meters
and two-place generators with increased precision, making up a phase meter-
ing system. In the present paper a new spectral method is proposed for
determination (separation) of the total errors of a phase metering system.
A block diagram and a discussion are presented of the system "calibrator of
phase--precise phase meter." In the discussion it is assumed that the
error curve of the phase meter does not change with the introduction of
other specified angles into a discontinuity of the system "calibrator of
phase--precise phase meter" and the function of the calibrator error shifts
with respect to the time axis and slightly changes its aspect. It is pos-
sible to expand the latter into a Fourier series and by such means to obtain
separately values of the errors of the calibrator and phase meter by pro-
cessing large masses of numbers of an electronic computer. It is shown
that this has a meaning only for highly-precise devices because the pro-
cessing is very time consuming. A sequence of operations is presented by
which an experimental check of the system is accomplished. With the aid
of the procedures discussed, fully qualified phase metering systems (cali-
brator of phase--digital phase meter) were developed at the Krasnoyarsk
Polytechnical Institute which have an error of several hundreds of a degree.
Figures 2, tables 1, references: 5 Russian.

USSR                                           UDC 621.317.775.029.5

CIRCUIT FOR MEASUREMENT OF DELAY TIME

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 5, May 77 p 77

VERTYSHEV, YU. A., and GOLENTSOV, V. N.

/Abstract/ A circuit is proposed, based on a ring oscillator, which makes
it possible to determine a delay time less than 1 nanosec for various delay
lines, commutators, and other high-frequency devices and their parts. The
error of measurement during measurement of a delay at 0.1 nanosecond amounts
to 5 percent. Figures 1, references: 2 Russian.

USSR                                           UDC 621.372.5.001.5

METHODS AND RESULTS OF INVESTIGATION OF THE REPRODUCIBILITY OF LOSSES IN
COAXIAL CONNECTORS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 3, Mar 77 pp 78-80

PAKAI, P. and TEREK, A., Hungarian People's Republic, FEDOROV, A. M., USSR

/Abstract/ A device developed at the State Administration of Metrology
(SAM), HPR, for measurement of small attenuations in quadripoles is des-
cribed, and the results are presented of an investigation of the reprodu-
ibility of attentuation in coaxial connectors. An analysis of the errors
of measurement of small losses in quadripoles with the aid of the device
described demonstrated that the total error of measurement (without mis-
match error) did not exceed several ten-thousands of a decible, which
agrees well with a theoretical calculation. The SAM device and the method
of determining the insertion losses in transitions and the reproducibility
of losses in connectors can also find use during an investigation of the
elements of waveguide channels. Figures 4, references 4: 2 Russian,
2 Western.

OPTIMAL RECEIVER SYSTEM FOR THE ACOUSTIC DETECTOR OPERATING WITH A RADIO
SPECTROMETER

GERSHTEYN, L. I., Scientific Research Institute of Radiophysics

/Abstract/ In a radio spectrometer with an acoustic detector the signal from an absorption line of a gas in the test cell is the fluctuation of the gas pressure due to heating, when the gas absorbs energy of modulated radiation. The essential component of the receiver system for such an acoustic detector is a membrane. A problem is the design of an optimal receiver with the maximum sensitivity to intrinsic thermal vibrations of the membrane in the presence of its dissipative thermal vibrations. This requires a resonance bridge supplied from a high-frequency source, instead of a transducer which directly converts mechanical energy to electric energy. Such a bridge circuit has been designed and its performance evaluated. With it included in a submillimeter spectrometer, the maximum sensitivity of $6 \cdot 10^{-9}$ $cm^{-1}$ at a radiation power of 10 mW and the minimum detectable membrane vibration of about $2 \cdot 10^{-5}$ Å with a time constant equal to 1 sec were attained experimentally. The author thanks A. F. Krupnov for constant attention to the work and S. P. Belov for helpful discussions. Figures 4, references 12: 9 Russian, 1 ?, 2 Western.

CZECHOSLOVAKIA

SOME MODIFICATIONS OF TESLA PCJ 07 COUNTERS

SPUNDA, JAN, engineer

[Abstract]  Two modifications of the TESLA PCJ 07 counters are described;
these are used when the standard design of the counter is not suitable for
some special applications.  Such application may be needed when compatibility
with equipment using a high-level logic signal is needed.  Other applications
may be in connection with TT1, negative levels, and similar cases.  Further
applications are concerned with modifying the counter to obtain a compact
time measuring assembly, or an accurate monostable flip-flop circuit with a
digitally specified impulse length.  Figures 2, references:  2 Czech.

# USE OF STRUCTURAL-TIME REDUNDANCY FOR CHECKING CONTROL CIRCUITS

ROMANKEVICH, ALEKSEY MIKHAYLOVICH, candidate of technical sciences, KPI
/Kiev Polytechnic Institute/, Kiev

/Abstract/ Timing redundancy, or excess time, which is available in the
overwhelming majority of circuits and systems is alsost never used as a
resource making it possible to improve some characteristics of circuits
without aversely affecting others.  It has been proven that it is not pos-
sible to simplify a combination-type control circuit by using timing, but
there is nothing in principle which says it is not possible to improve the
performance characteristics of control circuits by using timing.  This
paper deals with a number of problems and ways of solving them by using
timing redundancy for checking control circuits with test instruments.  The
specific methods suggested amount mainly to repeating the information pro-
cessing cycle to eliminate errors caused by component malfunctions.  The
basic idea behind these testing methods is to add some structural redundancy
in order to be able to use the timing redundancy available, while the main
goal is to reduce this structural redundancy (as compared with the redundancy
used in instantaneous testing) while retaining test capabilities.  Achieve-
ment of this main goal will make it possible to arrive at a solution to the
general problem of finding optimum methods of synthesizing and checking con-
trol circuits which will ensure the certainty of operation necessary for
them with specific restrictions on intricacy and speed.  Types of circuits
in which timing redundancy is present are those whose required speed is
below the capabilities of the component structure, as well as circuits which
are part of a system in which information is processed nonsimultaneously
by all units, i.e., those which have pauses in their functioning.  Excess
time available in a circuit's operation and used for test purposes is
called the "test time margin" (ZVK), which is further divided into two
types:  Active (AZVK), and passive (PZVK).  The AZVK presupposes that it is
possible to block off the control circuit being tested from external influ-
ences for a certain time interval, during which an experiment is conducted
on the circuit, such as feeding to the circuit's input channels a certain
test sequence of input variables for checking purposes.  The AZVK occurs
in control circuits which have regular pauses in their operation.  Analysis
of the circuit's operation during the experiment should make it possible
to make a judgment on the good working order of the circuit.  The PZVK
leaves no room for making a special experiment but makes it possible to put
out a signal reflecting the malfunction a certain time after it occurs.
For combination-type circuits the AZVK makes it possible to detect errors
of both the malfunction and failure variety, whereas the PZVK allows the
detection of failures alone.  The AZVK is used most effectively in testing
circuits with a single output.  A theoretical analysis of various testing

technics utilizing these concepts is presented. It is demonstrated that
certainty of control circuit operation increases in degree in all instances
in which the AZVK is utilized effectively and increases in proportion to
the length of the PZVK interval, when these concepts are applied to testing
methods to achieve control circuit optimality. References: 9 Russian.

LIMITATION OF PULSE NOISE IN A MODULATION RADIOMETER

DANILOV, V. I., Scientific-Research Institute of Radiophysics

/Abstract/ Sufficiently strong pulse noise in a modulation radiometer can
produce signal distortions, as a result of the time-lag nonlinearity in
the high-frequency channel. Zero-lag limiters connected into this channel
weaken such a noise more effectively than amplifiers with a wider dynamic
range. The problem of selecting the proper limitation level is considered
here in the case of a limiter at the input to a square-law detector. The
radiometer output signal is calculated as the difference between two con-
stant components of the process at the detector output, one associated with
connecting the antenna to the amplifier input and one associated with
matching the load. The results indicate that the estimator bias is inversely
proportional to the pulse spacing and, as the limitation threshold is lowered
decreases to some minimum while the estimator dispersion increases. In order
to reduce the fluctuations of the output signal in the absence of noise, it
is thus necessary to raise the limitation threshold. Figures 1, references:
4 Russian.

A FREQUENCY DISCRIMINATING OPTRON

IGUMNOV, D. V., TEREKHOV, V. A. and DUGINA, V. A., Moscow Institute of
Radio Engineering, Electronics, and Automation

/Abstract/ Optrons with frequency discriminating characteristics are used
for a galvanic decoupling of control circuits. The device shown here uses

an IED-photodiode pair in the input stage and a piezoelectric transformer, shunted by a resistance, as the discriminating element in the output stage. Voltage-current characteristics obtained experimentally for a GaAs light-activated diode, a Si photodiode, an zirconate-titanate piezoceramics indicate that a maximum output voltage is attainable with a certain combination of input current and shunt resistance. This paper is recommended by the Department of Industrial Electronics, Moscow Institute of Radio Engineering, Electronics, and Automation. Figures 2, references: 4 Russian.

INTERACTION OF DIPOLES IN A SHIELDED STRIP LINE

VUL', V. A.

/Abstract/ Utilization for pulse and digital computational technology of the nanosecond and subnanosecond range requires the investigators of new unique forms of spurious effects. In particular, this pertains to interference induced by direct radiation from inhomogeneities included in balanced strip lines. It has been shown that inhomogeneities located in flat strip conductors of a balanced line radiate several orders weaker (and their radiation quickly dies down in space -- at distances comparable with the extent of the inhomogeneities) than inhomogeneities located perpendicular to the strip in question, i.e., prolonged in the direction of the vector of the electrical field in the line. In the present paper, the interaction is considered of elementary radiators that are excited by an rf signal or video pulse in a shielded strip line. Relations are given for calculating the shape and level of the signal that is induced by the emitting dipole in the receiving dipole. The author believes that the graphs obtained make it possible to calculate the structural parameters of nanosecond and subnanosecond units with spurious interaction of their elements taken into account. Figures 3, references: 6 Russian.

USSR UDC 621.375.024

# A PRECISION LIMITER WITH THE USE OF OPERATIONAL AMPLIFIERS

POLONNIKOV, D. YE. and CHERNYSHEV, R. N., Moscow

/Abstract/ Enlargement of a class of problems which are solved on analog
machines and hybrid computing systems imposes high requirements on individ-
ual solving devices. To such problems, for example, pertain problems of
linear programming, optimization, and optimum control, where in the majority
of cases the precision of solution is determined by the precision of limi-
ters. Consequently, during the creation of analog systems, in which errors
of solving devices are balanced, it is necessary to increase the precision
of limiters to the level of precision of linear solving devices. At
present, precision limiters are constructed in accordance with a parallel
type circuit, in which nonlinear feedback is introduced with the aid of
supplementary operational amplifiers. The basic shortcoming of limiters of
this type is the fact that in the feedback circuit two amplifiers are con-
nected in series, as a consequence of which it is necessary to decrease the
speed of response of the system substantially in order to assure stability.
The present paper is concerned with a method of construction of a precision
limiter, based on disconnecting the main operational amplifier, and free
from the above-mentioned shortcomings. The properties and the static and
dynamic characteristics of the limiter are investigated and a comparative
evaluation is made of the quality of a limiter with disconnection of the
main amplifier, and a limiter of a parallel type. It is found possible to
recommend a limiter with disconnection of the main amplifier in all cases
when it is necessary to operate a limiter with small static error with a
high speed of response. Figures 5, references: 5 Russian.

USSR UDC 621.375.4:681.327:621.387.322.3.001.2

# USE OF ELEMENTS OF THE "LOGIC-T" SERIES FOR CONNECTION OF DIGITAL NEON DISPLAYS

LITKE, E. YE., engineer, and TAYNITSKIY, L. S., engineer. GPI /? Gor'kiy
Polytechnical Institute imeni A. A. Zhdanova/ TYAZHPROMELEKTROPROYEKT
/State Planning Institute for the Planning of Electrical Equipment for
Heavy Industry/

/Abstract/ The paper considers the use of elements of the "Logic-T" series
for direct connection of digital neon indicators. The basic circuit of
such a connection is shown as well as a connection diagram of the logic

elements and the neon display. The circuit described for connection of digital neon displays is characterized by simplicity and economy. It was tested successfully in a counter with an IN-4 display in the temperature range 5--45° C, with variation of the feed voltages of ± 10 percent from the rated voltage. Use of elements of the "Logic-T" series for direct connection of digital neon displays makes it possible to improve the design and the power indices considerably and to increase the reliability of its operation. Figures 2.

CZECHOSLOVAKIA

DESIGN OF TOPOLOGY AND MORPHOLOGY OF METAL-OXIDE-SEMICONDUCTOR MICRO-
ELECTRONIC CIRCUITS

MACK, ZDENEK, TESLA - A. S. POPOV Research Institute for Telecommunication
Engineering, Prague

/Abstract/ In the design of topology and morphology of MOS microelectronic
circuits comprising large scale integration, the design of individual func-
tional units, which are assembled on component chips, represents the basic
design problem. The design method developed by the author can be used for
a broad concept of a single step realization of the circuit, avoiding
iteration of analytical approaches. It also offers the design of optimized
circuits by an economically sound method. The optimization criteria con-
sidered by the author are: functional speed, area required for the circuit,
current intensity in the circuit feed, immunity from interference, and the
extent of possible applications of the system. The design method for
static logic circuits is the one developed to the greatest extent at present.
The key problem is the design of the invertor. The input data for the
study of a problem are: input and output levels of the logical load, immun-
ity from interference, area required for the circuit and the allowable load
in the circuit. The method uses these data to select the optimum parameters
of the invertor. Figures 8, references 12: 6 Czech, 6 Western.

Oscillators, Generators and Modulators

DIFFRACTION-RADIATION OSCILLATOR WITH A SPHEROCYLINDRICAL OPEN RESONATOR

KORNEYENKOV, V. K., PETRUSHIN, A. A., SKRYNNIK, B. K., and SHESTOPALOV, V.P., Institute of Radiophysics and Electronics, Academy of Sciences, Ukrainian SSR

/Abstract/ An experimental study was made of a spherocylindrical open resonator with a periodic structure, in the form of a narrow strip, partly covering the cylindrical reflector along its generatrix. The dependence of the resonator design and of the oscillator performance on the radius of the resonator design and of the oscillator performance on the radius of the cylindrical reflector is analyzed here on the basis of several variants, all with different radii of the cylindrical reflector and the same radius of the spherical reflector, for the purpose of optimization in terms of tuning range, output power, and starting current. An optimal resonator for a 4-mm wave diffraction-radiation oscillator has actually been built and, on the basis of the test data, the feasibility of 2-mm wave diffraction-radiation oscillators with such a resonator could also be established. Figures 5, tables 2, references 9: 8 Russian, 1 Western.

REDUCTION OF ERROR OF SETTING OF THE FREQUENCY OF OSCILLATIONS IN A CONTROLLED FUNCTION GENERATOR

BOL'SHAKOV, V. P.

/Abstract/ A method is presented for calculating the dynamic and static components of the error of setting the frequency of oscillations, connected with the nonlinearity of conversion of the input controlling voltage in the current charging and discharging of an integrating capacitor. A procedure for calculating the static error is described and a method for decreasing this component is proposed. As a result of the calculation it is determined that the bottom of the subband of the maximum current strength has the maximum value of the static error. It can be decreased if the transmission factor of the input scaling amplifier becomes a larger unit. In order to obtain higher metrological characteristics of a controlled function generator, construction of a unit for control of frequency is recommended,

the circuit of which is shown. The variation of the units for control of the frequency considered can be achieved on the basis of integrated microcircuits. An evaluation of the metrological characteristics makes it possible to recommend the units for use in controlled function generators and voltage converters—of a frequency of the average class of precision. Figures 4, references: 3 Russian.

Photoelectrics; Photoelectric Effect

STRUCTURE AND CHARACTERISTICS OF AN OPTIMAL FILTER FOR AN OPTICAL PHOTO-DIODE DETECTOR

MURADYAN, A. G. and GINZBURG, S. A., Central Scientific-Research Institute of Communications, Moscow

/Abstract/ Photodiodes are used as radiation detectors on the receiver end of optical transmission cables, with a filter connected behind the amplifier across the photodiode load. The spectral density of noise at the amplifier input is calculated here on the basis of an equivalent circuit diagram. With the aid of known expressions for the transfer function of a noise-optimal filter and the square of the peak signal-to-noise ratio at its output, the required optical power at the photodetector is found for the case of a Gaussian photocurrent pulse and an allowable error probability of about $10^{-9}$. This power is inversely proportional to the load resistance. Figures 3, references 3: 1 Russian, 2 Western.

DEPENDENCE OF THE EFFECTIVE DURATION OF A ONE-ELECTRON VOLTAGE PULSE OF A PHOTOMULTIPLIER ON THE SIZE OF THE RC LOAD AND SUPPLY CONDITIONS

KONDILENKO, I. I., KOROTKOV, P. A. and GOVORUN, D. N.

/Abstract/ The authors consider the problem of estimating the effective duration of a one-electron voltage pulse released across the RC load of a photomultiplier tube. The effective duration is defined as the ratio of the area under the pulse to its amplitude. An expression is derived for the effective pulse duration for an 11-dynode photomultiplier tube. It is shown that the dimensionless effective duration of a one-electron voltage pulse in a photomultiplier is considerably dependent on the dimensionless time constant of the RC load and the conditions of the supply. In the region of low loads, the effective duration of a one-electron pulse is independent of the dimensionless time constant of the load. Curves are given that can be used to find the effective duration of a one-electron photomultiplier voltage pulse and the effective width of its spectrum as functions of the supply voltage. Figures 2, references 9: 8 Russian, 1 Western.

USSR                                    UDC 621.383:535.231.63

PHOTODETECTOR DEVICES IN THE COMPOSITION OF THE COMPLEX GSE ORPM, IM AND
SPM

VASIL'YEV, YU. S., MANZON, A. D., KHAYKIN, N. SH., KHATYREV, N. P.,
CHERNOYARSKIY, A. A., and YAKOVLEV, V. A.

/Abstract/ Photodetector devices (FPU) are used in the following basic
systems of State Special Standards (GSE): laser radiation (in the composi-
tion of GSE--spectral density of power /SPM/, relative density distribution
of power /ORPM/, pulse power /IM/); measurement of relative density dis-
tribution of power in the beam of laser radiation (in the composition of
GSE-ORPM) and measurement of the power of pulsed coherent radiation (in
the composition of GES-IM). The paper considers the principal requirements
imposed on photodetector devices and connected with the possibility of
their operation in the above systems. A choice is made of photodetector
types, and on their base photodetector devices are constructed. The results
are presented of an evaluation of the stability and the divergence from
linearity of the photodetector device with respect to the conversion ratio.
Figures 2, tables 2, references 2: 1 Russian, 1 Western.

USE OF MULTICHANNEL ULTRASONIC MODULATORS IN SYSTEMS OF OPTICAL MATCHED
FILTERING

BUKHARIN, N. A., GRIGOR'YEV, V. A., YESEPKINA, N. A., PRUSS-ZHUKOVSKIY, S. V.,
and ROGOV, S. A., Leningrad

[Abstract] The method of optical matched filtering is widely used to solve
various problems of identification of objects, correlation processing of
signals, creation of storage devices, and other items. Achievement of
optical systems using the principles of matched filtering requires the
preparation of special filters, the passing through function of which
(transfer function) is equal to the complex-conjugate spectrum of the input
signal. As a rule such filters are produced by the holographic method. The
results are presented in this paper of an experimental investigation of an
acoustic-optical device which accomplishes matched filtering, as applied to
the problem of correction of phase errors in the aperture of an image antenna.
These results, in respect to the conducting of matched filtering with the aid
of multichannel ultrasonic modulators, can also be used in other systems with
matched filtering, in particular in the case of identification of objects,
the creation of holographic storage, and the like. Figures 7, references 9:
7 Russian, 2 Western.

OPTICAL RECTIFICATION IN AN EXTERNAL RESONATOR

VASYUNINA, N. P., ZANADVOROV, P. N., and MOLDAVSKAYA, V. M., Scientific-
Research Institute of Physics, Leningrad State University imeni A.A. Zhdanov

/Abstract/ The static-polarization effect during optical detection was
amplified experimentally by means of a nonlinear crystal inside a Fabry-
Perot resonator. A ruby laser with Q-factor modulation was used as the
radiation source. Frequency and modal stability were checked continuously
with a Fabry-Perot interferometer, an objective lens, and a photographic
camera. Points on resonance curves were plotted for various reflection
coefficients of the inlet mirror, and the static polarization was measured
at resonance. The resonator losses are now analyzed theoretically, and a
comparison with the experimental data, by the method of least squares, indi-
cates the ranges of accuracy. Figures 5, tables 1, references: 2 Russian.

USE OF A METAL-OXIDE-METAL DIODE FOR MULTIPLYING AND MIXING LASER
FREQUENCIES WITHIN THE NEAR INFRARED AND THE VISIBLE RANGE

DOLGOPOLOV, S. G., KLEMENT'YEV, V. M., KOVALEVSKIY, V. I., and
MATYUGIN, YU. A.

/Abstract/ A high-speed MOM diode, with a lag time of the order of $10^{-15}$
sec and with a nonlinearity probably caused by the tunneling effect, was
used for extracting the third harmonic of the $CO_2$-laser frequency and for
mixing it with the frequency of an He-Ne laser ($\lambda = 3.39 \mu$m). This diode,
consisting of the tungsten whisker in contact with a polished nickel cathode,
was also used for detecting radiation at 1.15 and 0.63 $\mu$m wavelengths.
The tungsten wire, 0.2 mm long and 6 $\mu$m in diameter, has been electro-
chemically etched down to a diameter smaller than the incident wavelength
so as to make an effective antenna. The results of the experiment indicate
the suitability of such a diode, contingent upon further improvements in
the recording apparatus, as a mixer for use in the near infrared and opti-
cal range of wavelengths. The authors express their appreciation to
V. G. Gol'dort and B. A. Kurnevich for development and production of a low-
noise wide-band preamplifier. Figures 1, references 5: 2 Russian, 3 Western.

EFFECT OF DISCHARGE BUILDUP IN FLASH LAMPS ON THE EFFICIENCY OF LASER
PUMPING

BASOV, YU. G., MOROZOVA, S. G., and TOKAREVA, A. N.

/Abstract/ A study was made concerning the discharge buildup in model
IFP-800 flash lamps placed inside or outside laser luminaires, and concern-
ing the effect of discharge anomalies on the laser efficiency. In the first
part of the experiment discharges were photographed with a model SFR-2M
camera in the continuous-sweep mode, cylindrical luminaires of various sizes
and with various reflection coefficients were used, and the parameters of
discharge dynamics were measured at two different power densities (50 and
250 kW/cm$^3$). In the second part of the experiment the efficiency of a
laser on yttrium-aluminum garnet with neodymium was measured, with dielectric
reflectors deposited on both bases of the crystal, and with the cylindrical

luminaire having either a specular reflector (silver foil) or a diffuse
reflector (sintered $SiO_2$). The test results indicate that a shift of the
lamp away from the reflector axis, in the case of a specular reflector,
results in an asymmetric discharge and, consequently, a lower laser effi-
ciency. In order to ensure a high laser efficiency, it is necessary that
discharge in the flash lamp build up and proceed uniformly. The metallic
case of the laser head should be be used as the ingiter electrode but,
instead, the latter should be placed directly on the lamp. Figures 6,
tables 1, references 29: 9 Russian, 14 Western, 6 German.

INFLUENCE OF RESONANT PROPERTIES OF THE DISCHARGE OF FLUCTUATIONS OF He-Ne
LASER EMISSION

ZABORTSEVA, T. A., LEVCHENKO, A. S., OSTAPCHENKO, YE. P. and STEPANOV,V. A.

/Abstract/ The paper gives the results of studies of the influence that
current modulation in the frequency band up to 1 MHz has on the behavior of
the output power of He-Ne laser emission in different modes of operation.
A diagram of the experimental setup is shown in the figure.
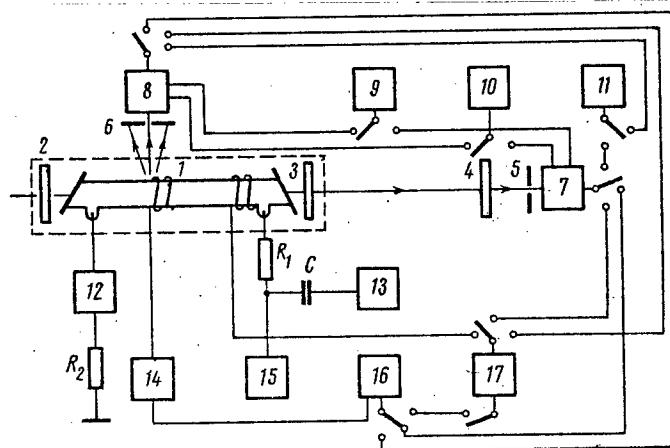
Figure 1

Key: 1. active element
     2,3. mirrors
       4. neutral filter
     5,6. iris diaphragms
     7,8. photomultipliers
       9. power supply for
          the photomultipliers

10. microammeter
11. microvoltmeter
12. milliammeter
13. audio-frequency
    oscillator

14,17. nanovoltmeters
   15. power supply for
       the active element
   16. oscilloscope

150

The discharge current was modulated by the audio-frequency oscillator through a 1000 pF transfer capacitor. Fluctuations in the current were detected from the change in voltage across resistor $R_2$. Power fluctuations were analyzed by the photomultipliers. Curves are given showing the spectral density of power fluctuations as a function of the frequency of the modulating signal for various percentage modulations, additional inductances and currents. The results show that the laser is an oscillatory system that can resonate in a certain frequency range. The resonant frequency is determined by the discharge parameters. Plasma perturbation in the vicinity of the resonant frequency may cause intense modulation of emission. Figures 4, references 6: 5 Russian, 1 Western.

A DIFFERENTIAL ELECTRO-OPTICAL SHUTTER

GUSEV, M. YE. and NOVIKOV, M. A.

/Abstract/ An optical shutter for Q-switched lasers is proposed in which the modulation factor of the output emission is determined by the time derivative of the modulating signal rather than by its amplitude. The working principle of this shutter automatically precludes the influence of natural birefringence and thus extends the range of possible crystals that can be used. In addition, the proposed shutter can utilize the transverse electro-optical effect, which reduces the required control voltage. Although the proposed element can use Faraday and Kerr cells, in this paper the authors consider only Pockels cells as modulating elements. An arrangement is described in which the shutter is used for pulse chopping in a Q-switched ruby laser. The electric pulse is shaped by a laser discharger. The proposed shutter can be used to produce optical pulses of nanosecond and sub-nanosecond duration. The shape and duration of the output pulses can be varied over a wide range of simply shifting the reflecting mirror rather than by varying the shape and amplitude of the control voltage as in conventional shutters. When used as one of the mirrors in the laser cavity, the shutter could be very convenient for emission of isolated picosecond pulses in the case of mode-locked lasers. The authors thank A. I. Makarov and V. S. Averbakh for providing the laser discharger, and Yu. K. Verevkin for assistance with the pulse measurements. Figures 4, references 4: 2 Russian, 2 Western.

# INVESTIGATION OF METHODS OF LOCAL HEATING OF THERMOPLASTIC CARRIERS

MITROFANOVA, L. A., Kiyev

/Abstract/ Dynamic transparencies are used in systems of optical processing of information for operational recording and erasure of information on individual sections of carriers. As is known, for processing of thermoplastic carriers (TPC), i.e., for transformation of an image into visible form or for its erasure, it is necessary to heat a given part of the carrier to the melting point of the TPC. Various methods of heating TPC exist. The present short communication investigates the temperature conditions of local heating of TPC. Three methods of local heating described in the literature are studied: 1) Heating of TPC with transmission of direct or alternating current through the elements of resistance matrices of different configurations applied to a glass substrate (the construction of an element of a resistance matrix is shown); 2) Heating of the TPC with exterior arrangement of heating element; and 3) Heating of the TPC by high-frequency currents. Figures 5; tables 1; references: 3 Russian.

# ROLE OF MULTIPHOTON AND IMPACT IONIZATION IN THE BREAKDOWN OF DIELECTRICS BY PICOSECOND LASER PULSES

VINOGRADOV, AN. V. and FAYZULLOV, F. S., Institute of Physics, imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

/Abstract/ The results of experimental studies concerning the breakdown of translucent dielectrics by picosecond laser pulses indicate that the threshold energy density varies inversely with the radiation frequency and is about one order of magnitude lower than in the case of nanosecond pulses. This can only be explained by the multiphoton mechanism of ionization, rather than by the impact mechanism alone. Here the relative contribution of each mechanism is analyzed theoretically. Numerical calculations of the threshold electric field intensity as a function of the pulse duration and of the threshold energy density as a function of the threshold electric field intensity, at the radiation frequencies of $1.78 \cdot 10^{15}$ and $3.56 \cdot 10^{15}$ $s^{-1}$, confirm the conclusion that both multiphoton and avalanche ionization must be considered in this case. The work was reported

at the Third All-Union Conference on the Physics of the Effect of Optical Radiation on a Condensed Medium; Leningrad, Nov 74. Figures 2, references 11: 10 Russian, 1 Western.

MECHANISM OF DEVELOPED EVAPORATION OF GLASS UNDER THE INFLUENCE OF LASER RADIATION

BELOZEROV, S. A., ORLOV, A. A. and ULYAKOV, P. I.

/Abstract/ A mechanism is suggested for developed evaporation of glass, based on reradiation of light in the evaporated material, which can explain the primary experimentally observed regularities of the process. Effects related to the initial stage of absorption of laser radiation in a transparent dielectric require special analysis and go beyond the framework of the report. The primary experimental results were produced in a study of the effect of pulses of duration 1.5 ms with beam spread $3 \cdot 10^{-3}$ on type K8 optical glass. The laser radiation was focused on the front edge of a polished specimen in a spot 0.2 mm in radius. The process of development of cavities was studied using high-speed microscope cinematography. The experiments established a linear dependence between the rate of evaporation and the light flux. The balance of energy upon stable evaporation of the matter under the influence of the laser radiation indicates that the energy absorbed in the dielectric is only 1 percent of the incident energy. Because the surface evaporation occurs in a layer of material not exceeding the thickness of the heating zone, $10^{-5}$ cm, the result produced means that the coefficient of light absorption in a thin layer of glass should increase sharply. A layer of highly heated gas or high-temperature heat source is formed before the evaporating glass surface. Light quanta with energies exceeding the width of the forbidden zone of the dielectric (4 eV for optical glass) will cause photoionization in the $10^{-5}$ cm thick layer, corresponding to the path length of photons in the area of fundamental absorption of the glass. The flux of these quanta forms a certain concentration of photoelectrons $N_e$ in the surface layer of the glass, and these electrons absorb the laser radiation. The authors express their appreciation to Yu. P. Rayzer for helpful discussion of the work. Figures 2, references 9: 8 Russian, 1 Western.

A LASER BASED ON YTTRIUM-ALUMINUM GARNET WITH NEODYMIUM FOR GENERATING A
HIGH-POWER FOURTH HARMONIC IN THE PERIODIC PULSE MODE

ABAKUMOV, G. A., BAGDASAROV,KH. S., VETROV, V. V., VOROB'YEV, S. A.,
ZAKHAROV, V. P., PIKEL'NI, V. F., SIMONOV, A. P., FADEYEV, V. V., and
FEDOROV, YE. A., Physicochemical Institute imeni L. Ya. Karpov

/Abstract/ The feasibility is demonstrated of building a laser based on
yttrium-aluminum garnet with neodymium which will generate high-power
radiation at its fundamental as well as second-, third-, and fourth-
harmonic wavelengths (1064, 532, 355, and 266 nm respectively) with a
pulse repetition rate equal to 20 Hz. This laser consists of an opto-
electronic modulator, a first diaphragm, an oscillator, a second diaphragm,
a resonator mirror, a telescope (a concavoconcave lens plus a convexo-
convex lens), an amplifier, a second-harmonic oscillator, a fourth-harmonic
oscillator, and a dispersing filter (quartz prism). All components are
series manufactured, and so are all components of the pumping system.
The maximum energy of a fourth-harmonic pulse at the filter output is
about 35 mJ, its peak power is about 5 MW (half-width of the pulse 7 ns)
and its maximum average power is about 0.7 W. Figures 2, references:
1 Russian.

CONCERNING ONE METHOD OF RECORDING HOLOGRAMS WITH THE AID OF AN ACUSTOOPTICAL
LIGHT MODULATOR

VOVK, YU. V., GIBIN, I. S., PEN, YE. F. and SHCHEPETKIN, YU. A., Novosibirsk

[Abstract] This short communication is concerned with an experimental investi-
gation of the possibility of recording of the holograms of a one-dimensional
binary word in a pulse regime, with the use of one acustooptical cell instead
of the two described in the literature. A block diagram is shown of the
experimental apparatus, which contains a He-Ne laser, an electrooptical
modulator, a light divider, a collimator, an acustooptical light modulator
(ALM), a system of mirrors for forming a reference beam, the Fourier-objectives
of object and reference channels, and a photographic plate. An acustooptical
cell is used as an ALM, which is illuminated by two light fluxes of equal

intensity:  Object B and Reference A.  The information being registered, presented in the form of a series of rectangular electrical pulses, modulates the amplitude of a sinusoidal carrier frequency, and is transformed by the acustooptical cell into a succession of trains of sound vibrations.  In order to form the reference beam in this same cell, one more pulse is generated with a duration equal to the duration of the signals, during which in the course of the exposure time, the signal pulses move in Zone B, and the reference in Zone A.  The merits of the proposed method are:  1) Complete compensation of the Doppler shift of the frequency of the light of the object beam; and 2) An additional acustooptical cell is not required for formation of the reference wave.  Figures 3; references:  3 Western.

FORMATION OF A HOLOGRAPHIC LIGHT-BEAM SPLITTER IN A HOLOGRAPHIC ·
OPTOELECTRONIC MEMORY SYSTEM

BERESTNEV, S. P., VASIL'YEV, A. A., YEZHOV, V. A., KOMPANETS, I. N., and POLYAKOV, A. M., Institute of Physics, imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

/Abstract/ The use of holographic optics as light-beam splitters for form- ing a signal beam and a reference beam greatly simplifies the optical system of a holographic memory.  One serious problem is matching the recorded raster of holographic light-beam splitters with that optical system.  It has, there- fore, been proposed to record the raster directly in the optical system. This method applies to an optoelectronic memory where the rasters of holo- grams and light-beam splitters are spaced symmetrically with respect to the optical axis of both the objective lens and the transparent which form the signal beam.  The raster of holograms is obtained here by projecting, to the same scale, the raster of light-beam splitters onto the plane of the informa- tion carrier by means of an optical system consisting of an objective lens and a contolled transparent.  An advantage of this method is the possibility of superposing the raster of light-beam splitters on the raster of holograms. It is also possible here to compensate, during image restoration, the dis- tortions due aberrations of the objective lens.  The feasibility of such a corrective image restoration has been demonstrated experimentally.  The authors thank P. V. Vashurin for assistance in the work. Figures 3, refer- ences 9: 4 Russian, 5 Western.

A LASER AS A MEANS OF TRANSFERRING A STANDARD FREQUENCY INTO THE
SUBMILLIMETER RANGE

DOMNIN, YU. S., TATARENKOV, V. M. and SHUMYATSKIY, P. A., All-Union Scientific Research Institute of Physicotechnical and Radiotechnical Measurements, Moscow

/Abstract/ An HCN-laser has been developed which duplicates the 890,760 MHz frequency with the precision of a standard. It operates on the principle of automatic frequency and phase tuning against a standard signal with an accuracy of the order of $10^{-11}$. When the laser frequency is measured by beating it with a harmonic of a centimeter- or millimeter-wave klystron, then the laser spectrum is much narrower than the spectrum of the standard signal multiplied to the same frequency. The laser thus has a higher momentary stability and can also be used as a source of the reference signal for stabilizing the frequency of a 4-mm wave klystron. The klystron requires a wideband automatic phase tuning for suppressing ambient 50-Hz fluctuations. The automatic phase tuning of the laser serves as the narrowband filter. The laser-stabilized 4-mm wave klystron is now phase-locked with a 3-mm wave klystron. The resulting laser-klystron (74,232.5 MHz) - klystron (8,247.5 MHz) system has a high momentary stability and its narrowband (a few Hz) automatic phase tuning against the standard signal is thus possible. The laser frequency is controlled by a movable resonator mirror. Figures 2, references: 3 Western.

A PICOSECOND SOURCE OF COHERENT OPTICAL RADIATION TUNABLE OVER THE 350-680 nm
RANGE OF WAVELENGTHS

GYUZALYAN, R. N., SARISYAN, D. G., and TER-MIKAYELYAN, M. L., Institute of Physics Research, Academy of Sciences, Armenian SSR, Ashtarak

/Abstract/ A new picosecond laser has been developed which is tunable over the 350-680 nm range of wavelengths. A line continuously tunable over this range was found in the spectrum of a $LiIO_3$ nonlinear crystal pumped from a picosecond neodymium laser at the wavelength $\lambda = 1.06 \mu$m. It has been shown to result from a simple shift, by the crystal, of one frequency in the continuous spectrum of this laser which the latter produces in the crystal. A

spectrogram of the tunable radiation is shown, with the second harmonic ($\lambda = 530$ nm) at the center. The wavelength has also been plotted as a function of the crystal orientation angle, i.e., the angle between its optical Z-axis, and the direction of the $\lambda = 1.06 \mu$m beam. As this angle increases from 24 to 51°, the wavelength of the tunable radiation decreases from 680 to 350 nm. Figures 3, references 9: 8 Russian, 1 Western.

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SMOOTHING THE ESTIMATE OF AN ENERGY SPECTRUM MADE WITH AN OPTICAL COHERENT SPECTRUM ANALYZER BY MEANS OF A MULTIMODE LASER

SAL'NIKOV, I. I.

[Abstract]  A multimode laser is used for frequency smoothing of a spectrum measured in optical coherent spectrum analyzers.  The laser field then also has transverse modes and the latter may be regarded as a superposition of plane waves propagating at certain angles to the resonator axis.  In a model LG-75 gas laser, for instance, the angular distance between adjacent transverse modes is approximately 41", while the beam-divergence angle is 10', so that there will be 15 averaged spectral components, and this is sufficient for smoothing the estimate of the energy spectrum.  Figures 1, references 4: 2 Russian, 2 Western.

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CONTROL FROM ELECTRONIC COMPUTER OF LIQUID-CRYSTAL TRANSPARENCY

KASPEROVICH, A. N., NALIVAYKO, V. I., PROKOPENKO, V. I., SOLONENKO, V. I. and STERELYUKHIN, V. A., Novosibirsk

[Abstract]  This short communication describes a liquid-crystal transparency for construction of coherent images, switching of the cells of which is accomplished by an electron beam, and the electronic system which connects the transparency with an electronic computer.  The principal object of the work was an experimental test of the possibility of using a step-by-step elemental method of construction of images in coherent light, uninterrupted in time.  In other words, it was necessary to make certain that the overall time of elementary construction of the image would be less than the storage time of an elementary cell of the transparency.  The liquid-crystal transparency

was prepared on the basis of a cathode-ray tube (CRT) which has a screen consisting of a glass plate penetrated by fine wires, the ends of which are reflecting elements of the CRT. In the present instance the number of these wires equalled $10^2$ pieces/mm$^2$. The CRT had electrostatic control and focusing. However, for an increase of resolution it was supplied with additional electromagnetic focusing. A layer of liquid crystal with a thickness of approximately 20 micron was arranged between the screen and the conducting semitransparent cover glass. Modulation of the coherent light reflected from the screen took place because of the effect of the dynamic diffusion in the Type MBBA liquid crystal during the introduction to it of an electric field with the aid of an electron beam. The working field of the CRT is 40 x 40 mm. The electronic system which connects the transparency with the "Elektronika-100" miniature electronic computer is intended for forming signals, controlling of the deflection of the electron beam in the CRT, control of the modulator of the CRT and conversion of parallel codes, which are read from the memory of the electronic computer, in series. Block diagrams are shown of the electron system for introduction of images from the electronic computer into the coherent optical system, and of the optical system which uses a He-Ne laser ($\lambda = 0.63$ micrometer). The authors thank M. A. Gofman for assistance during recording of holograms. Figures 4, references: 4 Russian.

ANALYSIS OF PARAMETERS OF HETERODYNE-TYPE CORRELATOR BASED ON AN ULTRASONIC LIGHT MODULATOR

KULIKOV, V. V., Leningrad

[Abstract] One of the promising trends in the solution of problems of image processing is the use of optoelectronic correlators of the heterodyne type. In the present brief communication the possibility is considered of using an ultrasonic light modulator (ULM) for spectral analysis of the interference pattern of the Fourier forms of the image being compared, and the dependence of the signal-to-noise ratio on the parameters is determined. An experimental device is used for confirmation of the possibility of using an ULM in a heterodyne-type correlator. The scheme of the correlator includes the following units: transparencies with recording of signal $f_1(x;y)$ and reference $f_2(x-a;y)$ functions; two converting lenses; an ultrasonic light modulator; the generator of a signal with linear interpulse modulation; a photomultiplier; band-pass filter; and an oscillograph. Figures 2, references: 2 Russian.

HUNGARY

INVESTIGATION OF THE DISTRIBUTION OF INFORMATION WITHIN THE SPECTRUM
OF TWO-DIMENSIONAL IMAGES WITH COMPUTER AND BY OPTICAL MEANS

TOKES, SZABOLCS, scientific group leader, DABOCZI, MARIA, research
technician, and BERBEKAR, GYORGY, assistant staff scientist, Research
Institute for Computer Technology and Automation, Hungarian Academy of
Sciences

/Abstract/ Experiments were conducted with Fourier-transform holograms to
investigate the distribution of the information in two-dimensional coherent
images through their Fourier spectra.  In order to establish the informa-
tion carried by the individual parts of the hologram and which information
is essential, parts of the transform of the object, of the spectrum, were
removed and the object was reconstructed from the incomplete spectrum.
This operation was called filtration in an electrical analogy because the
signal formation was made in the space-frequency region.  The experiments
were repeated by optical means and it was found that the results of the
computer experiments are valid.  The digital model developed in the course
of the experiments is also suitable for the examination of the transmission
characteristics of synthetic apertures, in the case of both diffuse and
non-diffuse objects.  The computer method is simpler than the optical
method, and thus only the former will be developed further. Figures 16.

CONCERNING THE ACHIEVEMENT OF AN OPTOELECTRONIC ARITHMETICAL DEVICE BASED ON CONTROLLED TRANSPARENCIES

KOMPANETS, I. N., MTSKERADZE, G. SH. and ORLOV, L. A., Moscow

[Abstract]  It is known that use of optoelectronic and computing devices make it possible to increase considerably the rate of information processing by presentation of digital information in the form of two-dimensional arrays, and the use of parallel algorithms of its transformation.  The overall principles of construction of optoelectronic arithmetical devices (OAD), discussed in three previous works by L. A. Orlov and Yu. M. Popov show that OAD must possess a number of significant advantages.  In the present work the problem is raised of achieving one of the variations of an OAD based on controlled transparencies.  Principal consideration is given to the choice of optoelectronic elements and the overall layout of the optical channe.  In so doing existing materials and elements are used, and such parameters as speed of response, power consumption, and dimensions cannot be optimized because they are determined primarily by the material of the controlled transparencies, which at the present time is still not definitely determined. In order to reduce the work necessary to produce the controlled transparencies, the scheme is selected of a two-discharge binary processor which fulfills two operations:  addition and multiplication of the whole numbers $A = 00a_3a_4$ and $B = 00b_3b_4$.  Nematic liquid crystals are used as the material for the controlled transparencies.  The crystals have good energy and optical switching characteristics and chiefly make it possible with relative simplicity to create the multielement units on their basis.  The effect of dynamic scattering of light in liquid crystals in used.  Both blocks -- optical and electronic -- are assembled in the form of a single device, at the input of which the light beam from a laser is presented.  The OAD developed satisfactorily carries out the assigned tasks of addition and multiplication.  The authors thank V. V. Nikitin for constant attention to the work and S. P. Berestnev for assistance in making measurements.  Figures 3, references: 3 Russian.

# TWO-COORDINATE LOOP DEFLECTOR WITH CONTROL QUASI-OPTIMUM IN TIME

GROMILIN, G. I., KASPEROVICH, G. YE., KIBIREV, S. F., PROKOPENKO, G. S., and
CHERNYSHOV, A. I., Novosibirsk

[Abstract]  One of the principal elements of hologram storage devices are
light-deflectors, which may be acoustoptical, electrooptical or electro-
mechanical.  The last of these is characterized by small losses of light
power, a high signal-to-background ratio and low costs.  However, as shown
in the literature, the principal shortcoming of such devices is their low
speed of response ($\sim$1 ms).  The present brief communication describes a
two-coordinate loop deflector (for 32 x 32 positions) with a special control
device which makes it possible to reduce the switching time of the light beam
to 100 microsecond.  Principal consideration is given to a description of the
structure, the principles of action and the results of an investigation of the
control device.  A block diagram is shown of the deflector (controlled by an
electronic computer) which includes a laser, four objectives, a Dove prism,
two deflecting galvanometers for x and y coordinates, and a device for control
of the deflector.  The authors thank V. M. Aleksandrov and P. Ye. Tverlokhlev
for the initial statement of the problem of increasing the speed of response
of a loop deflector and for discussion of the experimental results.  Figures
7, references:  3 Russian.

# PROBLEMS OF OPTIMIZATION OF PARAMETERS OF POSITION-SENSITIVE DATA UNITS FOR LASER TRACKING SYSTEMS

BOYTSOV, V. A. and KRYZHANOVSKIY, G. A., Academy of Civil Aviation

[Abstract]  Great potentialities in the field of trajectory measurements of
moving aircraft have been revealed by the employment of laser tracking systems,
the feasibility of use of which is caused by a significant increase in pre-
cision of determination of the parameters of the trajectory measured.  The
high-precision characteristics of laser tracking systems are determined to a
considerable extent by the type and parameters of the photodiodes, and, in
the case of the use of position-sensitive photodetector--data units, their

precision of conversion of the linear shiftings of the light spot reflected from the target of a laser beam, into an electrical signal corresponding to the mismatch between the axis of the receiving-transmitting device and the line of sight. At present in laser tracking systems, various forms of highly reliable position-sensitive data units are widely used, one of the variations of which are quadrants of analog type. The error of measurement of the trajectory which is obtained with the use of data units of this type, in the case of other similar conditions (i.e., with fixed characteristics of receiving-transmitting optics, effect of environment, etc.), is primarily determined by the values of two parameters--the geometry of the space between the quadrants and the stability of the function which determines the position sensitivity. The present paper considers the principal parameters of position-sensitive data units of laser tracking systems and problems of optimizing these parameters are formulated. A method is presented for solving the problem of optimization based on a parametric approach. The connection between the proposed method and the results of its use with the method of dynamic programming is noted. The paper is recommended by the Department of Aviation Electrical Equipment, Academy of Civil Aviation. Figures 2, references: 5 Russian, 1 Western.

NUMERICAL CHARACTERISTICS OF THE ENVELOPE RATIO OF A NORMAL RANDOM PROCESS

RYBAKOV, B. S.

/Abstract/ In practical application, in particular during solution of
problems of monopulse radar, it is necessary to know the numerical charact-
eristics of the ratio or its logarithm, of two readings of the envelope
sum of a deterministic, signal and normal narrow-band noise. In the present
paper, the first and second moments of the envelope ratio and its logarithm
are calculated. Approximate formulas are given for special cases of strong
and weak signals, and also for the region of weak correlation. References:
5 Russian.

ANALYSIS OF THE EFFECT OF NOISE ON DISCRETE RANGE-TRACKING SYSTEMS

MELEZHIK, V. A.,

/Abstract/ The problem of analyzing the effect of noise on discrete range-
tracking systems of discrete type, for which large intervals between arrival
of information concerning the coordinates of the target is characteristic,
arises to a wide extent in promising radar methods of discrete tracking of
a target. The present paper presents a technique for analyzing the action
of noise on such discrete range-tracking systems. The method is based on
using difference equations. Expressions are derived for determining the
dynamic and fluctuation errors of target tracking as a function of the
signal-to-noise ratio. Expressions are found for the way that the threshold
signal-to-noise ratios depend on the parameters of the tracking systems and
signals. Figures 4, references: 2 Russian.

INVESTIGATION OF THE PROPERTIES OF THE MUTUAL UNCERTAINTY FUNCTION OF
PULSE SEQUENCES WITH FREQUENCY-SHIFT KEYING

GONTARENKO, V. P. and KOSHEVOY, V. M.

/Abstract/ An analysis is made of the properties of mutual uncertainty
functions of composite frequency-keyed pulse trains. In contrast to
sequences with a linear law of phase-shift keying, such pulse trains can
be used in radar equipment to achieve both high resolution with respect to
range and velocity, and a low level of side lobes in the vicinity of the
central peak of the mutual uncertainty function. Figures 5, references 7:
6 Russian, 1 Western.

DETERMINATION OF THE SYNCHRONIZATION BAND IN PULSE-PHASE AFC SYSTEMS

KORYAKIN, YU. A. and LEONOV, G. A.

/Abstract/ The authors consider a pulse-phase AFC system with arbitrary
filters. A frequency criterion of stability is established for any initial
perturbations of such a system that gives an estimate of the lock-in band.
Derivation of this criterion involves a non-local study of nonlinear pulse-
phase AFC systems by the method of invariant cones proposed by Leonov for
studying cw phase AFC systems. The proposed criteria are used to determine
the effective lock-in bands for pulse-phase AFC systems with specific fil-
ters. Figures 5, references: 16 Russian.

CONDITIONS OF ATTENUATION OF INTERFERENCE OF COMBINATION CHANNELS OF A SUPER-
HETERODYNE RECEIVER BY A TUNABLE PRESELECTOR

SARAYEV, S. M.

[Abstract]  Proper selection of the intermediate frequency is an important
condition for attenuation of the sensitivity of combination reception channels.
However, the choice of intermediate frequency is not enough for tunable radio
receivers.  A second necessary condition is limitation of the receiver tuning
range, and a third is adequate preselector selectivity.  The author examines
the interrelation between these three basic conditions of attenuation of
combination reception channels in a superheterodyne receiver.  Relations are
derived that can be used in synthesizing the input module of a receiver as a
basis for selecting the intermediate frequency, tuning range and number of
resonant circuits in the preselector.  Figures 3, tables 1, references 8:
5 Russian; 3 Western.

ELECTRICAL PARAMETERS OF ULTRASHORT WAVE RADIOCOMMUNICATION RECEIVERS

Staff Report

[Abstract]  The main performance parameter of a receiver is its sensitivity,
which has been defined in Government Standard 12252-66 for FM receivers and
which one measures with a precisely defined normal test signal.  The next
performance parameters of a receiver are its nominal output power, its
selectivity in terms of immunity to interference from and intermodulation
with side channels, its frequency deviation, its nonlinearity, and its noise
immunity.  These and various other receiver test parameters are tabulated,
in relation to five different types of radio stations.  Tables 1.

Semiconductors, Dielectrics; Luminescence;
Solid State; Films

REDISTRIBUTION OF CHARGE CARRIERS AND NONRECIPROCAL EFFECTS IN THIN
SEMICONDUCTOR FILMS

BELYANTSEV, A. M., VALOV, V. A. and KOZLOV, V. A., Scientific-Research
Institute of Radiophysics

/Abstract/ Nonreciprocal effects related to the redistribution of charge
carriers in strong E and H fields have been observed in two-layer n-GaAs
films. In this work, the redistribution of charge carriers through the
thickness of the film and the related change in volt-ampere and Gauss-
ampere characteristics are described in the hydrodynamic approximation on
the assumption of constant free electron gas temperature. This approxima-
tion allows the simplest analysis of the properties of the films defined
by the spatial distribution of charge carriers. The assumption of constant
temperature is justified by the fact that the characteristic heating of
the field is independent of film thickness d and the concentration of free
charge carriers n, whereas the characteristic field at which redistribution
of carriers begins is dependent on n and d. The redistribution of carriers
has a significant influence on the galvanomagnetic effects in films; in
particular, the integral characteristics of films with heterogeneous dis-
tribution of parameters change when the sign of E x H is changed. In
strong electric and magnetic fields, carriers may be drawn toward the sur-
face area, the dimensions of which are much less than the Debye radius.
The structure of the Hall field and the distribution of carriers in certain
semiconductor films are determined. Figures 4, references 5: 4 Russian,
1 Western.

ANALYSIS OF THE CONVERSION PROPERTIES OF A DIODE WITH CONVENTIONAL
NONLINEAR CHARACTERISTICS

MALYSHEV, V. A. and CHERVYAKOV, G. G.

/Abstract/ Using a quasilinear method, the authors determine the amplitudes
of the combination components acted on by three signals, by a semiconductor
diode with conventional volt-ampere and volt-coulomb characteristics. On

the basis of a complete equivalent circuit they compute the frequency dependences of the coefficient of transformation with allowance of the load reaction for the cases of transformation by increasing and decreasing the frequency. Figures 3, references 8: 6 Russian, 2 Western.

ANALYSIS OF STEADY THERMAL FIELDS IN BARE SEMICONDUCTOR DEVICES WITH STIFF LEADS

MGEBRYAN, R. G.

[Abstract] Under steady-state conditions, the thermal field in active semi-conductor devices of bare construction is analyzed on the basis of the thermophysical model and the equation of heat conduction. The crystal with a junction and the leads are represented as a constant-intensity heat source and heat sinks, respectively, on the same side of a thermally insulating parallelepiped. By virtue of symmetry, this model can be reduced a simpler one with a single source and a single sink. The three-dimensional steady-state equation is then solved by means of integral transformations. The results, presented graphically, indicate that the internal thermal resistances can be minimized by using stiff beads instead of flexible leads and by optimizing the crystal thickness at a given distance from the heat source to the heat sink. As this distance is made longer, the thermal resistance will, beyond some point, increase proportionally with it. However, the proportionality factor decreases with increasing crystal thickness. Figures 6, references 6: 4 Russian; 2 Western.

REMOVAL OF PHOTORESISTS FROM THE SURFACE OF SOLID BODIES IN AN RF OXYGEN
PLASMA

KUBEK, JOZEF, engineer; LUBY, STEFAN; LALINSKIY, TIBOR, engineer; GULDAN,
ARNOST; Institute of Electrical Engineering, Slovak Academy of Sciences,
Bratislava; and GRMAN, DUSAN; Faculty of Chemical Engineering, Slovak
Technical University, Bratislava

[Abstract]  The authors developed a process for automatic removal of photo-
resists from the surfaces of solid bodies located in an RF oxygen plasma.
The photoresists are removed without mechanical effects and without the use
of corrosive chemicals.  During plasma removal of photoresists, inorganic
residues remaining on the surfaces are mainly metal compounds.  The base
material may undergo oxidation and in some cases may contain plasma charges.
The authors studied removal of photoresists from surfaces of Si, $SiO_2$ and
Al.  It was found that the amount of oxidation of Si and Al in the plasma
is negligible.  The authors developed a method of operation by which a
buildup of positive charges on $SiO_2$ surfaces can be suppressed.  Inorganic
residues were analyzed using an electronic microprobe.  A process of opera-
tion is described in which deposition of residues on surfaces of various
materials is minimized.  Figures 4, tables 1, references 10:  3 Czech,
1 Hungarian, 6 Western.

LIMITING FREQUENCIES OF STIMULATED EMISSION OF GUNN DIODES BASED ON $In_{1-x}Ga_xSb$, $GaAs_{1-x}Sb_x$, $In_xGa_{1-x}As$

PROKHOROV, E. D., BELETSKIY, N. I. and DYADCHENKO, A. V.

/Abstract/ The paper gives the results of studies of the emission efficiency of Gunn diodes based on $In_{1-x}Ga_xSb$, $GaAs_{1-x}Sb_x$ and $In_xGa_{1-x}As$ over a range of frequencies. The studies were based on the results of solution of a time-dependent kinetic Boltzmann equation. Efficiency-frequency curves are analyzed for the three types of diodes. The emission efficiency of $In_{1-x}Ga_xSb$ compounds is superior to GaAs and InP on frequencies of 1-10 GHz. For compounds close to GaSb the maximum emission frequency is 20-25 GHz, and as the compounds approach InSb the maximum emission frequency increases to 35-40 GHz. All the $GaAs_{1-x}Sb_x$ compounds have poorer frequency characteristics than GaAs, and show no promise for use in Gunn diodes except for special voltage-dependent frequency applications. For all compositions where band-band impact ionization is absent, $In_xGa_{1-x}As$ has a maximum frequency close to that of GaAs. For $x \sim 0.1-0.5$, these compounds have frequency capabilities superior to those of GaAs. Because the ratio of maximum to minimum voltage for these compositions is greater than that of GaAs, they would seem to be promising materials for making Gunn diodes. Figures 3, references 10: 7 Russian, 3 Western.

METHOD OF OBTAINING THE "SYMMETRICAL TRANSISTOR" EFFECT FOR A-C SWITCHES

ALIYEV, T. M. and MAMEDOV, R. I., Azerbaydzhan Institute of Petroleum and
Chemistry imeni M. Azizbekova

[Abstract]  A method is proposed for construction of an a-c switch based on
a transistorized circuit, which by convention is designated as a "symmetrical
transistor."  The principal circuit of such a switch is presented and described.
The basic unit of the switch consists of united transistors $T_1$ and $T_2$.  The
switchable voltage $U_t$ sin $\omega_t$ is supplied to the switch with the aid of the
secondary winding of a transformer.  In a saturation regime, with the alter-
nating component of the base current i $\delta_1$ of the transistor $T_1$, connected to
the inverse circuit, the negative half-cycle is decreased; and with the
alternating component of the base current i $\delta_2$ of transistor $T_2$, connected
to the direct circuit, the positive half-cycle is descreased.  The base
currents i $\delta_1$ and i $\delta_2$ are added  and the form of the alternating component
of the common current base i $\delta\sim$ of the united transistors takes a form
approaching that of an undistorted sinusoid.  Use of the a-c switch described
makes it possible to construct a simplified digital-analog converter, so that
in a K-category digital-analog converter the possibility appears of replacing
the K pulse transformers by one ordinary transformer.  Various types of
transistorized assemblies such as Series 159 microcircuits, which have small
deviations with respect to parameters, have been mastered and are series
manufactured by native industry.  With the use of "symmetrical transistors"
on a base of integrated microcircuits, the time-consuming process of selecting
transistors is eliminated.  This paper is recommended by the Department of
Electrical Measurements and Computing Technics, Azerbaydzhan Institute of
Petroleum and Chemistry.  Figures 2, references:  3 Russian.

# ENGINEERING METHOD OF COMPUTING THE NOISE FACTOR OF TRANSISTORS

POLIKARPOV, E. D., KARYAKINA, N. V., KHENKIN, E. A. and GOTOVTSEV, I. YA.

[Abstract]  The authors propose a nomogram which allows them to make an
engineering computation of the noise factor of transistors in the frequency
range studied here.  They find that this nomographic method is the best from
the viewpoint of clarity and universality.  This nomographic type computation
has an accuracy that is a function of the scale used.  In this case the
conversion parameters are selected in such a way that the accuracy of obtaining
a response from the nomogram is of the same order of magnitude on the average
as that of obtaining responses on a slide rule.  Figures 1, tables 3,
references:  2 Russian.

# PECULIARITIES OF SEMICONDUCTOR DEVICES IN MICROPOWER AMPLIFICATION EQUIPMENT

IGUMNOV, D. V., GROMOV, I. S. and FROLOV, V. N.

/Abstract/  The authors consider the amplification parameters and peculiar-
ities of using field-effect and bipolar transistors, optrons, and piezo-
electric transducers in microampere and nanoampere current ranges.  Relations
are derived for calculating the parameters of these semiconductor devices in
micropower amplification stages with accuracy sufficient for engineering
practice.  The current-voltage curves for field-effect and bipolar transis-
tors in microcurrent operation are described by essentially identical rela-
tions giving the output current as an exponential function of voltage.
Because the slope of the transfer characteristic decreases linearly while
the drain (collector junction) impedance rises with falling current, the
product of these parameters, which characterizes the amplification possibil-
ities of the transistors, remains practically constant in the microcurrent
range.  The voltage gain of a micropower amplification stage decreases
nearly linearly with a drop in the working current, and depends weakly not
only on the model and type of transistor, but also on its working principle
(bipolar, FET with pn junction, MOS transistor).  This is also the case for
a micropower amplifier with optron.  It is recommended that FET's, optrons
and piezoelectric transducers be used along with bipolar transistors in micro-
power amplification equipment. Figures 4, references 8: 7 Russian, 1 Western.

CZECHOSLOVAKIA

SOLID STATE ELECTRONIC DISPLAY SYSTEMS

PRIBYL, FRANTISEK, engineer

[Abstract]  The author discusses the functional principles of the design of solid state display systems.  Detection of the transmitted wave is made by means of photoelectric conductivity; picture reproduction uses electro-luminescence or liquid crystals.  Solid state display systems use electro-luminescent picture amplifiers.  The electroluminescent layer is located on a transparent $SnO_2$ electrode.  The leaders in this technology are General Electric and RCA.  Numerical displays produced in Czechoslovakia conform to the Standard CSN 36 9001, which describes Ga(As,P) diodes and liquid crystals. Flat picture screens use a layer consisting of CdS-ZnS-ZnSe.  The design is based on technique described in US Patent No 2,698,915 for W. Piper.  The receiver picture tubes are based on CdS and CdSe layers.  Their design uses the Charge-Coupled Device System, which is the most advanced one at present. Figures 7, references 8:  2 Czech, 6 Western.

CZECHOSLOVAKIA

A BALANCE MIXER FOR 3.6 TO 3.9 GHz FREQUENCY BANDS, A DIRECTIONAL SLOTTED 3 dB COUPLING MEMBER

OTYPKA, JIRI, engineer, and BURJAN, ZDENEK, engineer

[Abstract]  High-quality microwave mixers using GaAs Schottky diodes compete with microwave transistors as far as the most important performance parameter, the interference number, is concerned.  Transistors suitable for microwave preamplifying are not yet produced in Czechoslovakia.  However, TESLA VUST produces high quality GaAs Schottky diodes, either fully encapsulated or with protruding connections.  The limiting frequency for these diodes is 200 GHz.  When the internal circuits of the mixer are correctly designed, the diodes offer excellent performance.  The points of the diode are arranged for the second harmonic of the local oscillator.  The voltage is close to that of excitement of the mixer diodes.  The induction of the diodes is low.  Figures 13, tables 1, references 27:  2 Czech, 1 USSR, 24 Western.

Theoretical Aspects

OPTIMIZATION OF THE AMOUNT OF MONITORING OF SYSTEMS

BURLAKOV, YE. A., Leningrad

/Abstract/ The conduct of monitoring of the efficiency of complex radio-
electronic and electroautomatic systems at an optimum amount makes it pos-
sible to increase their reliability because of the resultant revelation and
subsequent reduction of discarded elements. On the other hand, the conduct
of monitoring is accompanied by negative effects on the system, resulting
from system connection and occurrence of failures in the process of conduct-
ing the monitoring. It is obvious that for a system it is possible to
determine the amount of monitoring and the trouble-shooting time of the
system in a connected state, such that the efficiency of monitoring is
maximum. The present paper considers the optimization of the amount of
monitoring, taking account of failures originating because of connection of
the system, in the more general arrangement when the time for conducting
monitoring is limited. An algorithm is proposed and an example of its use
is given. Tables 2, references: 4 Russian.

APPLICATION OF THE FOUR-COLOR MAP THEOREM TO AN ELECTRICAL NETWORK

TROKHIMENKO, YA. K.

[Abstract] In connection with the four-color map theorem, the following
statements are proved here: 1. Lemma about the degree of vertices: every
maximal type-A plane graph has at least one vertex of the third or the fourth
degree. 2. Corollary: in any type-A plane graph there is at least one
vertex of the fourth or a lower degree. 3. Theorem about four colors in a
type-A graph: the chromatic number of every type-A plane graph does not
exceed four. From this theorem follow many theorems on the basis of which
many radioelectronic and, particularly, microwave network design problems
can be solved. One such theorem states, in the form of a hypothesis, that
in a plane network with given node potentials not more than four of these
potentials need be different to make the branch currents not equal to zero.
This means that every intricate plane network with given node potentials can
be converted to a network with four nodes and with currents flowing in each
branch. This has been demonstrated empirically with plane networks (graphs)
containing up to 41 vertices. Figures 1, references: 2 Western (in trans-
lation).

ON THE STRUCTURE AND PROPERTIES OF COMPATIBILITY CRITERIA IN PROBLEMS OF
RELIABILITY AND PREVENTIVE MAINTENANCE

KORDONSKIY, KH. B. and ROZENBLIT, P. YA.

[Abstract]  The authors examine the problem of constructing criteria for
proving the hypothesis on the law of distribution with respect to situations
often encountered in statistical problems of reliability and preventive
maintenance of complex systems.  They give common arguments on the structure
and methods of constructing compatibility criteria similar to Pearson's
classical chi-square compatibility test.  For problems of preventive main-
tenance they suggest criteria based on permanent and partial sums of time
of trouble-free operation of statistically uniform elements and systems.  A
detailed study is made of the properties of the proposed criteria.  They
prove that the power of these criteria is greater than the chi-square test.
The authors give a practical example of using the criterion.  Tables 1,
references:  9 Russian.

CALCULATING THE THERMAL CONDUCTANCE OF THE CONTOUR SURFACE OF CONTACT BETWEEN
SOLID BODIES

KAPUSTIN, V. F. and TAYTS, D. A., Leningrad Institute of Precision Mechanics
and Optics

[Abstract]  Theoretical values of the thermal contact resistance do not agree
with real values.  A method of calculation is proposed here which will yield
more accurate quantitative results.  It is based on the concept of unit contact
elements along rough surfaces and an equivalent electric circuit of such an
element.  The fundamental differential equation of heat conduction is solved by
the Fourier method.  For calibration, the solution is compared with that for
a one-dimensional thermal flux along an equivalent cylinder.  This paper is
recommended by Department of Thermophysics, Leningrad Institute of Precision
Mechanics and Optics.  Figures 3, tables 1, references 6:  3 Russian, 3 Western.

SOME PROBLEMS OF THE PHYSICS OF HIGH-VOLTAGE NANOSECOND DISCHARGES IN
DENSE GASES

BABICH, L. P., LOYKO, T. V. and TARASOVA, L. V.

/Abstract/ The results are presented from experimental studies of nano-
second electric discharges in air at atmospheric pressure in fields with
intensities on the order of $10^5$ V/cm. Information is produced on voltage
pulses generated during the time of the discharge, conductivity currents in
the discharge gap and light radiation in various areas of the discharge. It
is shown that electrons with energies greater than the applied voltage are
generated with an increase in the conductivity current. It is concluded
that "runaway" electrons play a predominant role in the development of the
discharges. The generation of fast electrons with energies exceeding $eU_0$
occurs in that stage of the discharge when the cathode plasma already exists.
The experiments were performed in a discharge chamber with a massive cylin-
drical steel cathode with a hemispherical functional surface 6 mm in radius
and an aluminum foil anode 8 $\mu$m thick. The interelectrode gap was about
15 mm. Figures 4, references 35: 27 Russian, 8 Western.

ON AN APPROXIMATE COMPUTATION OF SYSTEM RELIABILITY WITH INSTRUMENT AND TIME
REDUNDANCY

KREDENTSER, B. P.

[Abstract] The author examines a system with mixed instrument reserve and
fast restoration of the broken-down elements. Approximate formulas are
obtained for the basic system reliability indicators such as the probability
of trouble-free functioning, average time to first failure, average time of
restoration and coefficient of readiness; an investigation is made of their
error. The results of the investigation are presented in the form of graphs
showing the dependence of relative error on the size of the minor parameter
and a number of other factors. The conditions are cited for which the ap-
proximate expressions can be used in engineering computations. Figures 4,
references: 5 Russian.

ON THE ROLE OF THE FUNCTION OF INDETERMINANCY OF A REFERENCE OSCILLATION IN
SPECTRAL ANALYSIS

GOLUBEV, YU. G. and SEREBRENNIKOV, V. I.

[Abstract]  Using the idea of an input signal with a Fourier series the authors
demonstrate that the output effect from a spectrum analyzer, containing a
heterodyne generating a reference oscillation and a filter matched with this
oscillation can be presented in the form of an expansion whose basic functions
are discrete cross sections of the function of indeterminancy of the reference
oscillation.  The coefficients of expansion are values of the spectral density
of the signal at the reference points determined by the duration of the ref-
erence oscillation.  Figures 3, references:  3 Russian.

THE AMPLITUDE-FREQUENCY EFFECT AS A MANIFESTATION OF ANHARMONIC VIBRATIONS

SMAGIN, A. G.

[Abstract]  An analysis of nonlinear phenomena in oscillatory systems has
revealed certain anomalies of the amplitude-frequency effect according to the
Krylov-Bogolyubov theory.  These anomalies are studied here with piezoelectric
excitation of vibrations in quartz specimens at 0.1, 0.2, 1.0, and 5.0 MHz.
The resonance characteristics were measured with the aid of a highly stable
electric oscillator which maintained the frequency accurately within $1:10^{-8}$.
Amplitude jumps of different magnitudes and at slightly different frequencies
were found to occur as the excitation amplitude and frequency were varied
upward and downward.  Measurements made on variously cut quartz specimens
have confirmed that the sign of the third-order elasticity coefficient $\beta$ is
responsible for these nonlinear changes in the resonance characteristics.
Furthermore, X-ray diffractograms have revealed wide variations in the
amplitudes of higher harmonics, typical of the anharmonic range of vibrations.
Measurements made over temperature ranges from below to above zero indicate
that variously cut quartz resonators, although they have very different
temperature coefficients of frequency, have similar amplitude-frequency
characteristics.  Figures 3, references:  3 Russian.

GENERATION OF THE THIRD HARMONIC UPON THE TWO-QUANTUM INTERACTION OF POWERFUL COHERENT LIGHT PULSES WITH RESONANT MEDIA

POLUEKTOV, I. A., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

/Abstract/ The generation of the third harmonic and parametric conversion of frequency $\omega$ of incident radiation has been studied for the case when the quantity $2\omega$ is close to the resonant transition in the medium. It is assumed here that $\Delta\omega \gg \max\{\Delta\omega_\ell, \Delta\omega_e, \Delta\omega_i\}$ where $\Delta\omega_\ell$ is the width of the $1 \rightarrow 2$ transition line; $\Delta\omega_e$ is the Stark shift in the radiation field; $\Delta\omega_i$ is the spectral width of an impulse. This work studies the opposite case, when $\Delta\omega \lesssim \max\{\Delta\omega_\ell, \Delta\omega_e, \Delta\omega_i\}$ and the power of the incident light satisfies the condition $\Psi_0 = (r_{12}^{(1)}/2\hbar) \int_{-\infty}^{\infty} \mathcal{E}_1^2(0, t)dt > 2\pi$; here $r_{12}^{(1)}$ is a second order matrix element; $\mathcal{E}_1(z, \tau)$ is the "slow" amplitude of the incident radiation. This situation causes a significant change in the condition of the medium, requiring that precise equations be produced and studied for polarization and the population without using field perturbation theory. This is performed using an ordinary system of equations for the amplitudes of probability $a_k$ of finding a particles of the medium at level k. Subsequently, four waves are studied: the primary wave with frequency $\omega_1 = \omega$, the third harmonic wave, $\omega_2 = 3\omega$ and two waves arising as a result of parametric conversion with frequency set $\omega_3$, $\omega_4$, satisfying the condition $\omega_3 + \omega_4 = 2\omega$. The influence of parametric frequency tuning on coherent effects which arise as light pulses propagate through a medium with double quantum resonant interaction is studied. It is demonstrated that pulsed third harmonic generation is possible. References 8: 5 Russian, 3 Western.

ON THE AVERAGE NUMBER OF COINCIDENCES OF SPIKES OF VECTOR RANDOM PROCESSES

BABUSHKIN, YE. F.

[Abstract]  The author studies the necessity of becoming familiar with the
statistical characteristics of the coincidences of spikes of vector random
processes in numerous radio engineering applications.  This is especially
the case in describing radio signals with frequency polarization, computing
the characteristics of processing information in vector communication channals,
and modeling complex systems.  In these problems the simultaneous outputs of
random vectors outside the boundaries of the allowable regions are identified
with the concepts of the state of the modeling process.  References:  7 Russian.

# ELECTRICAL ENGINEERING
## Electrical Engineering Equipment and Machinery

TESTING OF A MODEL TVV-320-2 TURBOGENERATOR DURING ASYNCHRONOUS MODES OF OPERATION

LEBEDEV, A. T., engineer, and MANGILEV, V. I.,candidate in technical sciences. Ural'skoye Otdeleniye ORGRES /State Trust for the Organization and Rationalization of Regional Electric Power Plants and Networks, Ural Division/

/Abstract/ The feasibility of operating large turbogenerators during asynchronism contributes to the continuity and the higher reliability of energy supply. A model TVV-320-2 generator was tested in this mode under initial load levels of 150, 200, and 300 MW, with various connections of the armature winding. Under normal conditions this generator fed 220 kV busbars, in parallel with two ouher such generators. It could be connected, through an autotransformer, to 110 kV busbars with a few other smaller generators. The field power was supplied either through a rectifier bank or from a separate exciter generator. All the auxiliaries, operating at 6.0 and 0.4 kV, were energized through a service transformer. An automatic emergency load dropping system had been provided for the event of excitation loss. The four tests included three with regular excitation and one with the standby excitation source. The results of these tests and their evaluation indicate that a model TVV-320-2 generator loaded to 300 MW will continue in operation during loss of excitation, if asynchronism is detected in time so that the load can be dropped to 120 MW and held at this level. The automatic emergency load dropping system was also tested and found satisfactory. Its wider use is recommended. Figures 4, tables 1, references: 3 Russian.

OPTIMIZATION OF DESIGNS OF POWER TRANSFORMERS

ZLATKIN, B. R., POVOLOTSKIY, L. YA., candidates in economical sciences, and TSIYER, G. I., engineer

[Abstract] Recently, in connection with economical reform, the value has increased of technical-economical evidence at various stages of development of new types of electrical engineering goods. The present paper considers this problem as applied to transformers of large power. Work with respect to the creation of a new transformer begins with the derivation, analysis and

study of the technical requirements of the buyer on the basis of the scientific technical stockpile provided and data concerning manufacturing and transport potentialities. Characteristic problems are discussed which occur in this first stage of development of new transformer equipment. At the second stage, the optimum values are determined of the principal dimensions and electromagnetic loads of transformers, based on the technical requirements approved at the first stage. The tasks of the second stage amount to a search for a variant of the transformer for which a minimum value of the target function of the national economic outlay is assured. These outlays are discussed and a table presents data concerned with various groups of transformers. Tables 1, references: 9 Russian.

PESHKOV, I. B., candidate of technical sciences

[Abstract]  Well-founded selection of test voltage can only be made if it is  possible to calculate the intensity of the electric field arising in the insulation of a wire at the moment of testing, and if the mechanism of breakdown of insulation during electric testing has been precisely determined. Theoretical study of the fields for the models used universally in the USSR and abroad of a wire and grounded plate and two wires in contact with each other carrying different voltages has resulted in the production of a precise solution for electric field of voltage in the insulation of wires and in the air.  Algorithms have been produced for computer calculation.  The method suggested for calculation allows objective determination of the test voltage of enameled wires.  When new types of wires are developed, this method significantly facilitates the problem, because after determining the test voltage for one size and  selecting the necessary safety factor it then becomes possible to determine the entire series of optimal test voltages for different wire diameters.  Figures 3, tables 1.

DESIGNING AND TESTING OF 400 kV LONG-ROD INSULATORS MADE OF SYNTHETIC RESIN

PAULUSZ, MIHALY, graduate electrical engineer, senior staff scientist, Research Institute for the Electric Power Industry

/Abstract/ The long-rod insulator discussed in this article was previously described in this journal (Vol 67, 1974, No 4-6). The following design criteria are discussed: resistance to contamination (ability to perform as rated after contamination in use), breakthrough voltage, and mechanical strength. The insulators were tested for the following properties: arcing voltage with switching wave, shock frequency, and industrial frequency; and mechanical strength (in the laboratory), and lifetime (in field trials). The results of the tests, presented briefly, indicate that the insulator meets the prescribed electrical and mechanical requirements. It is planned to build a test installation using approximately 30 such insulators in a 400 kV transmission line. If the results of this test are favorable, the insulators will be approved for large-scale manufacture. Figures 2, tables 3, references: 4 Hungarian.

METHODS OF REDUCING LOSSES IN STEEL SHEATHING OF A HIGH-VOLTAGE CONDUCTOR

KARASEV, V. V., candidate of technical sciences, FILIPPOV, A. YE., engineer

/Abstract/ Aluminum tubes with a wall thickness of approximately 5 mm are used in widely employed shielded conductors of generated voltage (GOST 19850-74). In the case of high-voltage conductors with electrical gas at a pressure of approximately 0.39 MP, tubes with a thicker wall are required. The most inexpensive and durable material for the sheathing is structural steel. However, as the paper shows, in steel sheathing the losses are greater and the heating is higher than in aluminum sheathing. The papers considers design measures concerned with a reduction of losses in steel sheathing, methods of calculating losses, and choice of the most efficient and technologically effective variation of its design. A comparison of the variations was made for a conductor with an external diameter of the sheathing of 1020 mm, and a diameter of the cores of 320/290 mm with a nominal current of 4000 A. In order to reduce losses in the steel sheathing of a phase-wound conductor with shorted sheathing, it is recommended that several aluminum or copper strips, uniform with respect to the circumference, be placed on its interior surface. For steel sheathings 600-1000 mm in diameter with three strips placed at an angle of 120°, the total losses are reduced 4-5 times. In order to reduce losses and heating on sections where the steel sheathing of the conductor is not shorted, it is recommended that aluminum strips closed among themselves be placed on the interior and external surfaces of the sheathing of each phase. Figures 5, tables 2, references: 6 Russian.

ACCELERATED RELIABILITY TESTING OF ELECTRICAL APPARATUS

BELEN'KIY, DMITRIY MIKHAYLOVICH, dr of technical sciences, professor Rostov Engineering-Construction Institute; BONDARENKO, YEVGENIY MIXAYLOVICH, candidate in technical sciences, scientific worker, VELNII /expansion unknown/ (Novocherkassk); MISHKOVICH, VLADIMIR IL'ICH, graduate student Rostov Engineering-Construction Institute

/Abstract/ Before accelerated testing under overload conditions, one must determine first the maximum overload level and then the conversion factors for reducing the test results to normal conditions. A method is proposed here for solving both problems simultaneously and for obtaining the necessary

information about the reliability of electrical apparatus within a minimum
test time with a limited number of test samples. The method is based on
the theory of planned experiments and a linear model of accelerated testing,
this model constituting a set of linear models all major individual elements
or parameters. The acceleration factor for the maximum overload levels is
the product of the acceleration factors for all preceding overload test
levels. This method will also yield the relation between variations of
the technical parameters and relevant influencing factors. Figures 1,
references: 7 Russian.

MEASUREMENT OF PARTIAL DISCHARGES IN INSULATION OF REACTORS WITH BALANCING OF
NOISE

LIZUNOV, S. D., SVI, P. M., FRID, YE. S., candidates of technical sciences,
and BAROMYKIN, O. V., engineer

[Abstract] A test of the insulation of power shunting reactors of 500-700 kV
classes with a voltage of commercial frequency is made with the use of a
capacitor bank by the resonance of voltages method. In so doing, the intensity
of the partial discharges is measured. In order to determine the partial dis-
charge with an intensity of $10^{-10}$ K1, a scheme was developed for measurements
with balancing of noise in which the electrostatic screen of a reactor is used,
divided into two symmetrically positioned sectors. During this it is assumed
that only partial discharges in the main insulation of the reactor are possible,
all currents of partial discharges are completed through the screen. It is
found that the scheme developed for measurement of partial discharges with
balancing of noise made it possible, during inspection tests of reactors
of Types RODTs--6000/500 and RODTs--11,000/750, to reduce the level of noise
to $5.10^{-11}$ and $5.10^{-10}$ K1, respectively, by an increase of the working voltage.
The scheme developed is used during inspection tests of reactors at a plant
and can be used for the purpose of performance checking of the state of their
insulation without taking them out of operation. Figures 4, tables 3, refer-
ences:  6 Russian.

NEW DISTRIBUTOR PANELS WITH VACUUM SWITCHES

KOSTRZHEVSKIY, B. YE., candidate in technical sciences, and SHAKSHUYEV, V. I., engineer

[Abstract]  A new small-size complete outdoor distributor panel with vacuum switches has been developed, mainly for 10 kV rural networks.  The experimental model KRYN-10 was built at the "Elektroshchit" Plant in Moscow and will be converted to the K-100 series production.  It consists of two cabinets, one 3000x1600x1450 mm$^3$ large contains five commutator cells laid out transversely and one cell where instrument-type potential transformers with discharge switches are located, the other 900x2800x1450 mm$^3$ contains an accessory transformer and the switchboard.  Each commutator cell includes part of the protective relaying, measurement-control-automation equipment, and a drive motor for the switch.  The prototype KRUN-10 unit cost 12-15,000 rubles.  Installation and operation of every K-100 unit should result in a saving of 1500 rubles per annum.  Figures 3.

TESTING OF SWITCHES IN THE MODE OF DISCONNECTION OF PERSISTENT SHORT CIRCUITS

GONCHAR, V. S., engineer, KAPLAN, V. V., NASHATYR', V. M., candidates of technical sciences

[Abstract]   Methods are presented for selection of the parameters of models of power transmission lines in which the inductance of the buses in the test installation is used as an element of the line model circuit, thus eliminating its distorting influence on the process of arc damping during testing of switches, and results are presented from practical application in testing of breakers at Leningrad Polytechnical Institute.  By using the principle of construction of the circuit here described, one can create widely varied line model systems fully equivalent to the initial circuits being modeled.  This is quite significant from the practical standpoint, since it allows complete compensation of the distorting influence of the inductance of the buses in the test installation and, secondly, satisfies a broad range of requirements for model parameters with limited laboratory equipment.  Figures 4; references: 5 Russian.

IMPROVEMENT OF PROTECTION OF MINIMUM VOLTAGE

KAPLAN, S. YU. Irtysh-Karaganda canal; KLETSEL', M. YA., engineer,
Pavlodarsk Industrial Institute; and POLYAKOV, V. YE., dr of technical
sciences, Ural Polytechnical Institute

/Abstract/ A device is proposed for protection of minimum voltage, without
the shortcomings of protection units used at present. The principle of its
operation is based on a comparison of the phases of the currents of electric
motors, taking account of the current at the leadin of a section of the bus-
bar from which they are fed. Tests showed that the device operates with
the disappearance for any reason of the supply voltage, irrespective of the
length of cable, the values of the load factors and the power of the elec-
tric motors, and of the residual voltage at the busbars, and does not
operate before cutting-off by the fast-response protection of a near-
external short circuit, a short at busbars and in electric motors, and also
during starts and stops. The devices were subjected to test operation
under laboratory conditions and at several pump stations of the Irtysh-
Karaganda canal. During testing the devices operated within 0.03-0.04
second after disconnecting the power supply, although in so doing the voltage
at the busbars did not fall below 0.93 $U_{nom}$, provided that it was maintained
by synchronous motors with 5 MW power. During the time of operation of the
device, breakdowns and erroneous operation were not observed. Figures 2,
references: 4 Russian.

# OCCURRENCE OF SPURIOUS SIGNALS IN TRAVELLING-WAVE TUBE AMPLIFIER

HIRMANN, JAN, LOM, TOMAS, TESLA -- Research Institute of Vacuum Electronics, Prague

/Abstract/ Optimization of transmission characteristics of travelling-wave tube amplifiers represents a typical systems engineering problem. The economy of operation of the amplifier is a complex function of the qualitative parameters of the transmitted signals and costs of equipment and of operation. Reliability of operation must also be considered. The nature of the modulation of the signal used strongly affects the requirements of linearity. A frequency-modulated signal is affected very little by amplitude distortion. This influence is only secondary because each AM signal may be synthesized from a complex of FM components. A simultaneous transmission of several AM signals needs the highest linearity of transmission characteristics. The efficiency of the system is important when the weight of the source of the electrical energy is the limiting factor. This occurs in applications in satellites, where even the most complex linearization circuit becomes economically justified. TESLA manufactures the TESLA VUVET 32 SE 1 travelling-wave tube amplifier used in television transformers operating in frequencies of the 4th and 5th television zone with amplitude signal modulation. The quality of the transmitted colored television signal is the most important factor of the system. Therefore the amplitude component of the transmission characteristics is linearized by an increase in the voltage of operations; this no longer represents an optimization from the aspect of maximum amplifications. The tube is operated at the peak of synchronization. The phase component of the transmission characteristics is linearized by a simple compensation circuit, which is affected by the amplitude of the exciting signal. Figures 8, tables 3, references 9: 1 Czech, 8 Western.

CONCERNING THE PROBLEM OF AMPLIFICATION OF A NOISE-LIKE SIGNAL IN AN
M-TYPE TWT

ZHELEZOVSKIY, B. YE., ZHELEZOVSKIY, YE. YE., KARIMOV, R. N. and
BLINAYEV, YU. V.

/Abstract/ An analysis is made of the amplification of microwave noises
in the M-type traveling-wave tube. Particular attention is focused on
injection of a noise-like signal directly into the slow-wave guide. The
computerized technique used in the calculations is based on solving a
system of equations that describes multiple-signal interaction between
the electron flux formed by the crossed fields and the traveling electro-
magnetic wave. The paper gives the results of calculations of the ampli-
tudes of field components in the slow-wave guide, the total microwave power
and the amplitudes of alternating components of the beam current. Con-
clusions are drawn concerning energy possibilities and design peculiarities
of M-type TWT's with amplification of a noise-like microwave signal.
Figures 7, references 6: 3 Russian, 3 Western.

A SYSTEM OF NONLINEAR EQUATIONS FOR NUMERICAL ANALYSIS OF TWT WITH
TRANSVERSE FIELD

VANKE, V. A. and ZAYTSEV, A. A., Moscow State University

/Abstract/ A qualitative illustration is presented of the mechanism of
interaction in a TWT with transverse field, and a system of equations is
formulated which allows a more complete description of the processes of
interaction of the electron beam with the field of the traveling circularly
polarized wave of the retarding system. The mechanism of grouping in a TWT
with a synchronous electron flux is studied qualitatively. The transverse
velocities of the electrons are considered, as is the heterogeneous,
axially symmetrical permanent magnetic field. Expressions are produced for
the space charge field. The process of grouping of electrons in the field
of the traveling circularly polarized wave is not related in principle to
the excitation of dispersion of longitudinal velocities in the flow, but

results rather from spatial curvature of the beam relative to the axis of the electrodynamic structure. The flux at the end cross section, arriving at the input of the interaction area, is essentially a sum of threadlike beams displaced from the axis. The stability and axial symmetry of the boundary conditions on the one hand and the circular polarization of the functional component in the wave field on the other hand allow the solution of the nonlinear three-dimensional problem to be simplified, representing it in a form suitable for numerical analysis. The authors are grateful to V. M. Lppukhin and V. I. Kanavts for attention to the work and for helpful discussions. Figures 5, references 9: 8 Russian, 1 Western.

CALCULATING THE GAIN AND THE SYNCHRONIZATION BAND AT A SUBHARMONIC FREQUENCY OF A VOLTAGE-TUNABLE MAGNETRON

GUTTSAYT, E. M., TERLETSKIY, N. A. and TEPLYAKOVA, YE. V.

[Abstract] The problem of controlling the output signal of a voltage-tunable magnetron is considered in the case where the frequency of the input signal equals a fraction of the self-oscillation frequency. The oscillator must then be designed for synchronous operation at a subharmonic frequency. This is done here, synchronization being treated as a combination of two processes: first multiplication of the input signal frequency of some higher harmonic, and then locking of the output signal at a frequency close to the self-oscillation frequency. The magnetron construction has been modified accordingly, so as to tune the resonator to an oscillation frequency a few times higher than the input signal frequency and so as to intensify the appropriate harmonic. The performance parameters of such a voltage-tunable magnetron are calculated here, namely the gain and the synchronization band. Its amplitude and frequency characteristics depend on the electronic admittance components. For operation at the second subharmonic frequency, the gain and the synchronization band have been plotted as functions of the input signal level and the harmonic power. The authors thank Graduate Students [diplomant] V. Abramov and Yu. Karpenko of the Moscow Power Engineering Institute for participation in the calculations published in the work. Figures 5, references 10: 7 Russian, 3 Western.

ACCOUNTING FOR RELATIVISTIC EFFECTS WHEN ANALYZING PROCESSES IN CASCADED-CAVITY KLYSTRONS

KHAYKOV, A. Z.

[Abstract] Expressions are derived to account for the velocity dependence of electron mass in high-power klystrons. The velocity modulation equation is solved as a series with respect to powers of the small parameter $\mu_k = E_k/2\gamma_e U_0$, where $E_k$ is maximum field strength, $\gamma_e = \omega/v_0$, $v_0 = \sqrt{2(e_0/m_0)U_0}\,\sqrt{R+1}\,\sqrt{2R}$, $R = 1 + (e_0/m_0 c^2)U_0$, $U_0$ is the accelerating voltage, and $\omega$, $e_0$, $m_0$, c have their conventional meanings. It is found that the variable components of the convection current and electron velocity in the cavity gaps with different interaction and in the drift tubes are determined by the expressions of the nonrelativistic approximation if special formulas are used for the instantaneous and total coefficients of interaction with fast and slow space-charge waves. An examination of energy relations in the output circuit shows that there is a considerable gain in efficiency of klystrons at high accelerating voltages because of the increased electron mass. The author thanks D. G. Fialkova for computer calculations. Figures 3, references 8: 4 Russian, 4 Western.

STABILITY OF TWO-FLUX STATES IN A MAGNETRON. PART 1

BELOV, V. YE. and RODYGIN, L. V., Scientific-Research Radiophysics Institute

/Abstract/ Electron-wave processes caused by transverse perturbations play a large role in the formation of an electron cloud in a magnetron during the pregeneration stage. Two-flux models of such an electron cloud inside a closed magnetron diode are considered here, this condition corresponding to zero velocity of electrons at the cathode. Its stability is analyzed on the basis of the fundamental equations of motion, with small perturbations and appropriate boundary conditions. The dispersion characteristics are determined, first for a plane model and then for a cylindrical model of the

electron cloud. The results indicate that curvature of the interelectrode (interaction) space reduces the increments of oscillations and, over a wide range of frequencies and current densities, may lead to stability. Many physical factors have been disregarded which may influence the electron-wave processes such as the discreteness of electric charges, lowering the upper frequency limit, and the role which the dispersion of electron velocities plays at the cloud edge with the cathode. Figures 1, references 9: 6 Russian, 3 Western.

NONSTATIONARY NONLINEAR PHENOMENA DURING INTERACTION BETWEEN AN ELECTRON BEAM MOVING IN CROSSED FIELDS AND A BACKWARD ELECTROMAGNETIC WAVE

KUZNETSOV, S. P. and TRUBETSKOV, D. I., Saratov State University

/Abstract/ An M-type backward-wave tube is considered with an electron beam moving in crossed fields and interacting with the backward electromagnetic wave. The basis equations of the system include one describing the excitation of the retarding stage and two describing the motion of electrons in terms of the bunching parameter and a special function of it. The law of energy conservation is also established here. The solution of the equations of motion, found on the basis of the nonlinear theory, represents a transient with damped oscillations. It departs from the solution based on the linear theory soon after the beginning of the transient, but after a few oscillations it again converges to the latter solution in the steady state. Any agreement between the transient periods according to both solutions is coincidental and the linear theory does not, generally, render an adequate description of the transients past the initial stage. Figures 6, references 11: 9 Russian, 2 Western.

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CZECHOSLOVAKIA

DESCRIPTION OF THE DEVELOPMENT AND PROPERTIES OF THE TESLA 51 SA 52
MAGNETRON DESIGNED FOR USE IN HOUSEHOLD MICROWAVE OVENS

FRIC, VIKTOR; STARY, ZDENEK; DOHNALEK, JARMIL; TESLA -- Research Institute
for Vacuum Electronics, Prague

[Abstract]  The authors describe the course of development of the TESLA 51 SA 52
magnetron which was prepared at the TESLA Research Institute for Vacuum Elec-
tronics.  The magnetron is of a CW type, incorporating an RF power supply of
700 W in the frequency band of 2375 MHz; it was developed primarily for use in
domestic microwave kitchen ranges.  The unit is air cooled; its magnetic field
is provided by an electromagnet.  It is characterized by a very low anode
voltage, similar to units offered in the West in 1975.  The cathode is fast-
starting, made of W-Th and operates with a constant voltage for ignition and
normal duty.  It provides the basis for large scale production of microwave
ovens in Czechoslovakia.  Methods of mode stability testing and of determina-
tion of cathode temperatures under various operating conditions of the
magnetrons are described.  Figures 8, references:  5 Western.

USSR                                                    UDC 621.385.633

A METHOD OF DEMODULATING THE ELECTRON BEAM IN O-TYPE DEVICES

BELYAVSKIY, YE. D.

/Abstract/ A nonlinear theory is extended to the demodulation of the
electron beam in an O-type device by a high-frequency field, the frequencies
of whose time harmonics are not multiples of the fundamental (modulating)
frequency. A one-velocity electron beam along the z-axis is considered
which has interacted with a high-frequency modulating field. It is shown
how this beam can be demodulated by harmonics of some lower frequency and
thus, in effect, by sub-harmonics. In this case, it appears, there is no
necessity for rigorously phasing the demodulating field at the input.
References: 3 Russian.


USSR                                    UDC 621.385.832.56:621.391.837.22

CALCULATION OF SYSTEMATIC COORDINATE DISTORTIONS OF RASTER OF TRANSMITTING
TV TUBES

PETRAKOV, A. V., All-Union Electromechanical Correspondence Institute of
Communications

/Abstract/ Causes and values of systematic coordinate distortions of the
raster of transmitting television tubes /TTT/ are analyzed. In TTT manu-
facture, defects cause deviations of 1° in any direction from the per-
pendicular of the target plane to the TTT axis. If the deviation from
perpendicularity is along the row, the speed of travel of the pixel
increases at the remote corners of rows and decreases at the opposite
corners. Nonlinearity of current with the deflecting coil can differ.
When the nonlinearity factor is 3-5 percent, the error is about 0.8 percent.
Systematic coordinate errors of a "light-to-signal" TV converter cannot be
minimized down to random error values of electrical methods. V. M.
Kharitonov, V. I. Torbayev, and V. F. Kalganov took part in processing
the experimental material. Figures 3, tables 3, references: 9 Russian.

Energy Sources

A DF-$CO_2$ CHEMICAL AMPLIFIER OF SHORT LIGHT PULSES

BASHKIN, A. S., GRIGOR'YEV, P. G., IGOSHIN, V. I., NIKITIN, V. YU., and
ORAYEVSKIY, A. N., Institute of Physics imeni P. N. Lebedev, USSR Academy
of Sciences, Moscow

/Abstract/ A chemical amplifier on the $D_2$+$F_2$+$CO_2$+He mixture is proposed
for generating nanosecond pulses. Energy is transferred here from DF*
molecules to $CO_2$ molecules constituting the laser medium. A chain reaction
between deuterium and fluorine can be triggered upon dissociation of
fluorine molecules $F_2 \rightarrow 2F$ by a beam of light or a beam of fast electrons.
The performance parameters of a 1:1:4:5 mixture are determined from a
mathematical model of the process kinetics developed in an earlier study
and supported by measurements. These parameters include three characteris-
tic time periods: the relaxation periods of transitions in one oscillatory
state, from one radiating rotational sublevel to all others and from all
others to one, and the oscillatory-oscillatory states exchange time. In the
case of pulses shorter than the first of these relaxation periods, the
specific energy delivered depends on the inversion of only one given
oscillatory-rotational transition. In the case of pulses longer than the
second of these relaxation periods, the specific energy delivered depends
on the total oscillatory inversion. In the case of pulses longer than the
exchange time, the energy delivered depends on a coefficient which is a
function of the gas temperature and of the temperature of $CO_2$ oscillations
in the antisymmetric mode. The total engineering efficiency of this device
is calculated for operating conditions of most practical interest in its
application to laser-controlled thermonuclear synthesis. Tables 3,
references 10: 7 Russian, 3 Western.

EAST GERMANY

EXPERIENCES AND RESULTS ON THE TRANSFER OF NEW PRODUCTS INTO SERIES PRODUCTION
USING AS AN EXAMPLE THE VKM CHANNEL MODULATOR STAND

East Berlin FERNMELDETECHNIK in German No 2, 1977 pp 69-71

EDER, G., Chamber of Technology, Leipzig

[Abstract]  The newly developed VKM carrier-frequency channel-modulator stand
was put into production during 1976 at the State Enterprise of Radio and
Telecommunications Technology [RFT] of the  Signal Communications Works,
Leipzig.  The aim of this new development consists in the production of an
article with higher serviceability and with a considerably increased working
productivity as compared with the predecessor product.  The new VKM stand was
given the Q quality symbol; its series production started in the first quarter
of 1976 and it reduced the production time by 50 percent as compared with the
predecessor product.  It increased the number of channels by a factor of 2.5
to 5, improved the reliability by a factor of 1.5, and decreased the con-
sumption of winding units by 80 percent.  The principal demands made on this
new development, the complex preparation of the series production and the
results of the production transfer are described.  The experiences gained
represent the rhythm according to which the intensification of production
in the Five-Year Plan up to the year 1980 must be continued.  Figures 1.

EAST GERMANY

UNIFIED STANDARDS FAVOR SPECIALIZATION, COOPERATION AND EXCHANGE OF GOODS IN
CEMA-COUNTRIES

East Berlin FERNMELDETECHNIK in German No 2, 1977 pp 71-72

TORNAU, F., Chamber of Technology, Leipzig

[Abstract]  Based on experience in the preparation of recommendations of CEMA-
countries, an agreement was made in the year 1973 between the USSR and the
GDR for a mutual regularization of state standards with the result of a
normalization of 88 GDR standards with the Soviet All-Union standards GOST.
The keypoint of this task pertained to electronic elements, electronic in-
dustrial consumer goods, electronic communication engineering, industrial
devices and scientific apparatus construction and optics.  At nearly the same
time, CEMA decided on the preparation of multifariously co-ordinated standards.
The main points of these tasks in the field of electrical engineering/elec-
tronics are indicated in the present paper, and the interrelation between a
two- and a multi-sided standardization task are discussed.  A coordination

of extensive standard aggregates for the simplification of technological processes is provided for the near future. This will include the parameters of the automatic control of technological processes as well as the means for supervision, measuring and the control of individual parameters. This report is from the Institute for Simplification of Electric Engineering/Electronics.

CZECHOSLOVAKIA                                          UDC 621.37/.39-192

A SURVEY OF METHODS AND PROCESSES USED IN THE DESIGN AND DEVELOPMENT OF RELIABLE ELECTRONIC SYSTEMS

BEDNARIK, JOSEF, dr, engineer; TESLA - A. S. Popov Research Institute for Communication Technology, Prague

[Abstract]  The author discusses the present day methods and processes used in Czechoslovakia for the design of reliable electronic systems. The design methods are affected by both technical and economical considerations. The entire national economy is affected by the degree of reliability of available electronic systems. It is most important that the aspect of reliability should be considered as the guiding design parameter. Well-defined relia-bility expressed by a definite "on stream" factor must be considered in the planning of all new production facilities. During the fifth Five-Year Plan the background for a rational design of all electronic systems was developed. In the sixth Five-Year Plan, efficient electronic systems are readily available. References 21:  17 Czech, 2 USSR, 2 Western.

HYDROXYL-FREE QUARTZ GLASS FOR LOW-LOSS FIBER OPTICS AND ITS COMPARATIVE
RADIATION AND OPTICAL CHARACTERISTICS

BOGANOV, A. G., DIANOV, YE. M., KORNIYENKO, L. S., NIKITIN, YE. P.,
RUDENKO, V. S., KYBALTOVSKIY, A. O., and CHERNOV, P. V., Institute of
Physics, USSR Academy of Sciences imeni P. N. Lebedev, Moscow; Institute
of Silicate Chemistry, USSR Academy of Sciences, imeni I. V. Grebenshchikov,
Leningrad; Scientific Research Institute of Nuclear Physics, Moscow State
University imeni M. V. Lomonosov

/Abstract/ A new method of synthesizing extra-pure hydroxyl-free quartz
glass is based on melting high-purity cristobalite powder under vacuum in
an electric furnace. The powder is made from granulated synthetic silicon
dioxide by an extra high-temperature heat treatment. It is thus possible
to produce 5-7 kg of slightly sintered 100 percent cristobalite under
laboratory conditions without raising the impurity level above that of the
raw material. Special techniques are used for a more effective removal of
vaporous metallic ingredients during the heat treatment. The optical
characteristics of this glass, its ultraviolet and infrared transmission
and absorption spectra, compare well with those of industrial grades such
as KSG glass (made of rock crystal). Its resistance to $\gamma$-radiation,
determined on the basis of electron-paramagnetic-resonance as well as
induced optical absorption and thermal stability measurements, improves
relative to that of grade KSG glass, as the radiation dose is increased
from $10^4$ to $10^8$ rd. The lower resistance to radiation effects is attributed
to the presence of modifier ions in the lattice. Figures 6, tables 3,
references 12: 3 Russian, 9 Western.

USSR                                    UDC 621.311.1.001

## CALCULATION OF BALANCED AND UNBALANCED REGIMES OF SUPERHIGH VOLTAGE POWER LINES

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/Abstract/ The possibility is considered of developing a mathematical model for calculation of complex forms of damage (transverse and lengthwise unbalance simultaneously) in power systems which contain electric power transmission lines (EPL) with distributed parameters. Calculation of unbalanced conditions is performed by a scheme in which an EPL is represented by a double-circuit, each circuit of which consists of two T-shaped units. In order to create transverse unbalance at any point of the line, a short circuit branch is introduced into circuit I, connected between the phases and the ground, but it is possible in a general form to represent the lengthwise unbalance by the inclusion in series, for each phase of circuit II, of different resistances. The earth serves as the zero conductor of the 3-phase EFL. It is concluded that the algorithm of the methodology presented possesses high reliability and speed of response, and satisfies the requirements imposed on the precision of calculation. The program makes it possible to calculate unbalanced regimes in lines with a two-way supply of any voltage, and it can also be used for determination of the initial conditions during solution of a system of differential equations which describe the behavior of a system of electrical transmission in transient conditions. The paper was submitted by the Department of Electrical Stations, Belorussian Polytechnical Institute. Figures 2, tables 1, references: 1 Russian.

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## THE PROBLEM OF STANDARDIZATION OF MEASURING ORGANS OF RELAY PROTECTION DEVICES

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/Abstract/ A study is made of the problem of standardization of the measuring organs of relay protection units. The primary operation in measurement

organs is the process of comparison of a given quantity with a certain standard, taken as the unit of measurement. A formula is developed for the log function which all measurement organs of relay protection systems actually perform /formula (9) in the article/. This function achieves differential-phase protection of electric power transmission lines against single-phase short circuits. This paper was presented by the Department of Electrical Stations, Networks and Systems. Figures 4, references: 2 Russian.

OPERATIONAL TESTING OF THE TECHNICAL CONDITION OF ELECTRIC POWER SYSTEM AUTOMATION AND PROTECTION DEVICES

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/Abstract/ One effective measure of increasing the reliability of functioning of relay protection and automation devices in power systems is to equip them with additional test apparatus -- status indicators (SI). The SI are to determine the status of the device being tested and send a signal in case a defect arises between preventive maintenance cycles. This provides for timely detection of defects and prevents failures or false alarm operation of relay devices. A regular method is suggested for synthesis of status indicators, allowing reliable automatic devices which provide timely information to personnel concerning the status of the automation and protection equipment with the minimum hardware expenditure. The paper was presented by the Electrical Engineering Department. Tables 3, references 2 Russian.

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